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ORGANIC FOOD: ROOTED IN LIES?

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Good evening Ladies and Gentlemen, and welcome to the first of my Gresham lectures to include a blind tasting test of food. The lecture, as you know, will look at the merits and potential disadvantages of organic food, focusing on its environmental implications in farming and beyond. Organic food production is environmentally benign, better for animal welfare, has human health benefits and tastes better, or so say its proponents. Conversely, detractors allege that the rapidly rising global population cannot be fed without using artificial fertilisers, herbicides and pesticides that their environmental impact is slight and manageable, and that 'organic' consumers are being duped by farmers. With a global market approaching £70 Billion, and with an estimated growth rate of 16% per year, there's a lot at stake, so the lecture will review the environmental science evidence, explore some of the alternative facts, and debunk a few myths.

We need to send apologies to those watching live at a distance, or looking later at the video, who will have to imagine the taste test. We are going to compare two organic products to non-organic ones and will review the outcomes during the talk. On balance I decided that carrots and biscuits were appropriate for tasting, so apologies to anyone that was hoping for chocolates or single malt whiskey. The audience here in London have tried the products, and whilst they remember their preferences, let's just take a vote on the better tasting carrots, and the better tasting biscuits. I'll reveal their 'organic' versus 'non-organic' preferences, later, and we will see if the taste claims for organic food are true according to the discerning palates of London attendees, or are mythical (if not very scientific).

Myths and untruths come in many shades, in relation to organic food and other environmental themes. The current media is full of references to 'fake news' and 'alternative facts', mainly arising from recent developments in the USA where it is now said that we live in a 'post truth' society. A 'post truth' society may be imagined as one where what people believe to be true is as appropriate or as correct as what might be asserted using more traditional means. But what we can 'know' and what we cannot 'know' are complex matters, as is how we know it. Some things may be settled by logic, working from the best available data, usually scientific data, that has been rigorously tested using standard scientific methods – typically by peer review of a draft, and publication in an openly-readable journal. Others may be something we just 'feel', albeit strongly. And verify by communicating with others who feel the same way.

Former Chancellor Nigel Lawson's 10th August 2017 pronouncements on climate change, on BBC Radio 4's Today programme, illustrate the shifting nature of 'facts', feelings and opinion very well. In an interview about the recent release of a new film on climate change by Al Gore, Lord Lawson said categorically that average global temperatures had 'slightly declined' in the past ten years. The actual quote is here in the slide. Lord Lawson is Chairman of the Global Warming Policy Foundation, a climate sceptic lobbying group whose funding source is not published. If we divide the quote into the two parts, the second part refers to increases in global temperatures, which based on the best available data collected by NASA and others, and analysed by the UK's Meteorological Office and University of East Anglia, is not true. Indeed, the Global Warming Policy Foundation has now revealed that the source of Lawson's figures was a meteorologist working for the Cato Institute, founded by US billionaire and leading climate sceptic, Charles Koch, and that the figures were simply wrong. They released this information in a tweet on 15th August, five days later. The best scientific information shows clearly that the overall trend is upwards, over almost fifty years, and that in the last ten years (not the appropriate range to consider, in my view) the increase is at a faster rate. Overall temperatures are up almost a



degree on the late 19th century, with 2016 the hottest on record, and 2017 shaping up to be in the top three years, as well. I wonder why Lord Lawson either made this assertion, or chose to believe this view, but also how widely that admission of error was read?

The first part of Lord Lawson's quote referring to the lack of evidence found by Intergovernmental Panel on Climate Change for the increased frequency of extreme events, continued to be supported by the Global Warming Policy Foundation, as you see here in their response to that. Lord Lawson continued to press his case on extreme events, saying "*[Al Gore] said that, er, there had been a growing increase, which had been continuing, in the extreme weather events. There hasn't been. All the experts say there haven't been. The IPCC, the Intergovernmental Panel on Climate Change, which is sort of the voice of the consensus, concedes that there has been no increase in extreme weather events. Extreme weather events have always happened. They come and go. And some kinds of extreme weather events of a particular time increase, whereas others, like tropical storms, diminish...*"

However, the IPCC's latest, or Fifth Assessment Report summary includes a useful diagram showing the results of their scientific analysis. You need to focus on the lines in yellow, which are an overall picture (whereas the blue and red texts refer to different model outcomes), and the first column that refers to changes observed since 1950. This clearly says that for most types of extreme event other than drought and tropical cyclones, the analysis suggests that increases in frequency of extreme meteorological events are 'likely' or 'very likely'. This 'likely' verdict is the result of analysis by a very large number of scientists, rigorously tested against the usual protocols. But it is still based on analysis of estimates, with error bars, since extreme events are by their nature less frequent and more difficult to analyse. Clearly, here is the one possibility for 'alternative facts' to be picked up, but perhaps not to the extent that Lord Lawson suggested. Personally, I'd regard his statement as an untruth of some sort.

Let us turn now to the matter of organic food, and farming, and myths. We have an image of organic food that implies 'natural', wholesome, environmentally benign. Even 'The Archers', a mainstay soap opera on British radio, has a cast including organic farmers who are, naturally, rather 'nice' people. Organic vegetables, honey, eggs, meat, fish and so on, are commonplace in the UK. There is a growing market for organic pharmaceuticals and beauty products, and indeed 'organic pharmacies', and the UK's Soil Association recently invited people to participate in 'Organic September'. Not all 'natural' products are benign, though; I imagine the Athenian state's hemlock infusion was likely to have been organic but it nevertheless killed Socrates. And we can also buy 'organic' cigarettes and tobacco if we wish, although legally they cannot be described as 'natural' and are likely to be lethal in the longer term. The rolling papers to go with them or other smoking substances, are also organic. So there is no direct equivalence between 'natural' or 'organic' and human wellbeing. Some 'natural products' of course, belie the fact that they are not at all 'natural' but are full of synthetic materials derived from the petrochemical industry, and some 'bio' type products are just wilful irrationality - this fuel additive, for instance, that apparently 'converts higher molecule to lower molecules'. Good stuff, evidently, and the producer is seeking investment at the moment, if you have a few thousand pounds to spare....

In general terms, organic food is nevertheless seen as enshrining specific qualities, some of which are 'certified' by inspection and labelling, for example by the EU, or the US Department of Agriculture. There are nine certification bodies in the UK and unfortunately the labelling schemes sometimes clash, something that is likely to become even more problematic after BREXIT. But typically, proponents think of organic food as being:

1. Produced by low input, quasi-natural agricultural systems, less dependent on herbicides and pesticides, and avoiding chemical residues, or on fossil fuels and their derivatives;
2. Healthier, and more nutritionally balanced than conventionally produced food;
3. Fresher, and better tasting, with shorter and speedier local supply chains;
4. Part of a circular economy with plant and animal wastes, and nutrients, returned directly to the soil;
5. Better for animal welfare, with low stocking rates, no antibiotics, access to the outdoors, quasi-natural diet;



6. Not damaging the environment, but preserving biodiversity, for example through 'heritage' breeds, and plants native to specific bioregions, and avoiding Genetically Modified Organisms (GMOs);
7. Socially sustainable, rejecting socially exploitative labour practices, and practising fair trade;
8. Necessary to feed the world sustainably, in the long term.

Centuries of debate has underpinned our current understandings of what organic food comprises; food is an integral part of interconnected and changing social, economic and political systems, as well as environmental systems. Farming in the west has evolved from the surface scratching of the earth and the encouragement of edible plants at the expense of those less obviously useful, through the waxing and waning of intensification and selective breeding, the use of additional inputs such as fertiliser (either mined or otherwise secured from natural sources, or compounds synthesised artificially), and equipment such as the plough, towards industrialisation, genetic manipulation and soil-less husbandry or hydroponics.

In reality, 'organic' is a highly contested concept, such that debate is sparked amongst those who are concerned about food quality, safety, nutrition and ecological sustainability, and also those people for whom social sustainability relating to workers' rights as we see in point 7, above is important. There has been concern about the health and safety of farm workers worldwide, for example through inhaling or otherwise ingesting pesticide sprays on cotton and tea in the developing world, and issues of human rights. Tomato planters and pickers in Florida have poor health, allegedly because of use of herbicides and pesticides, and widespread avoidance of the guidance and legislation on their use leading to workers being exposed. Hence both product-based (what we eat) and production-based (how it is produced) definitions of 'organic' exist; the second may include sociocultural and ethical issues not evident in the product, but relating to types of production.

Today's 'organic farming' has been informed by the research of Eve Balfour and Albert Howard in the 1930s. Together, they inspired the founding of the UK's Soil Association in 1945, believing that the health of soil, plants and animals, and people was 'one and indivisible', and championing organic techniques as an alternative means of production to the large scale industrialised systems that had escalated after WWI, and which had delivered stable food supplies at lower prices, albeit at the expense of family farms. Balfour, Howard and their colleagues were particularly concerned about the environmental implications of the use of synthetic chemicals, and cited depleted soil fertility, nutrient runoff, and water system pollution from farm waste, as problematic. Their ideas subsequently spread to Europe and the USA, becoming associated with the 'Back to Nature' romantic movement' of the 1960s, where alternative facts were inextricably linked with alternative lifestyles.

Initially, the organic scene might be viewed as an unequal battle between small family businesses and individuals supported by the Soil Association, and some of the larger agribusinesses – pesticide and herbicide producers, and large supermarkets, for instance, supported by some large lobbying organisations. The pesticide market internationally approaches £15 billion, for instance, and may be assumed to employ lobbyists. However, with the gradual growth and formalisation of the sector, some larger corporate players such as supermarkets have picked up the 'organic' baton, on a platform of 'safe', 'healthy', and 'local'. Even chains such as McDonalds, Pret, and Nandos have joined the fray. Moreover, there has been some bifurcation of low input organic products costing less, and being sold locally to reduce transport costs, versus high value niche organic products that are traded across the world - baby sweetcorn air freighted from Kenya to the UK, for instance, or Duchy Original biscuits. Indeed, you may have tasted one of the latter tonight. There are now huge commercial interests in both the maintenance and the shutting down of the organic food market, and hence controversy. The situation is more nuanced even than that, with vociferous critics including both those who deny any value in organic products, and those who say that the regulations on organic production are now too lax (the 'old guard'), and that the original integrity of 'organic' has been lost.

The scale of the global market, and its growth rate, is indeed eye-watering. From 1990–2000, certified organic food sales grew at an average of 25% per year, to reach £6 billion by April 2000, booming beyond that to £27 billion by 2013. Most of this was food, but the total organic market including non-food products such as pharmaceuticals and textiles in 2012 was about circa £50 billion. Today it approaches £70 billion. Organic



accounts for 4.2% of all food sales in USA, and with some two million producers globally. Business is booming and the estimated compound annual growth rate from 2015 to 2020 is 16%, according to US consultancy TechSci Research. Amazon food are now considering organic food as a principal product too, of a future service.

Growth in the UK was similarly strong, with a five-fold increase in value from 1995-2000 as consumers bought more and more organic food. But UK organic acreages make up only about 4% of the EU organic area, not a great proportion, and the Defra diagrams show what has happened recently. Whereas the UK land area given over to organic agriculture peaked in 2009, it has declined considerably since then, along with the areas moving towards organic status; it takes a couple of years (three years for fruit such as apples and pears) to achieve the relevant accreditation. The vast majority of that organic land is pasture – land supporting sheep and dairy production. You can see too, that the land given over to organic sheep production has also fallen significantly since 2011, whereas organic cattle and pig numbers remain roughly constant. For the plants, organic cereal acreages have dropped a lot since 2009, vegetables somewhat and other crops a little. Perhaps consumers are becoming more sceptical? Simultaneously, the Soil Association reporting this year said that there has been strong growth in the demand for organic food, its value growing 7.1% in 2016 alone, and organic food is now 1.5% of the total food and drink market. Now these figures do not square up in a simple way, though in my estimation it is unlikely that either of these organisations is actually lying. The possible explanations include a dramatic improvement in the yields of organic crops and livestock (more organic produce per hectare), or food being sold as ‘organic’ that is actually not, or a huge hike in the value of organic products, or (most likely in my view) a dramatic increase in the volume of imported organic produce from beyond the UK.

Why are people buying organic produce, at a substantial price premium over conventionally-produced food, at all? Are they just, as might be characterised by some of our media, upper class hippies, foodies, and believers in homeopathy, allotments and the women’s movement, with more money than sense? (That’s a joke!). There is no doubt that concern about the nutritional status of food has been a major driver, particularly for children’s diets amongst more affluent consumers. Tesco, for instance, have recognised this. Organic food is seen as healthier, and recent years have seen some horrific global scares that may have reduced trust in mainstream food production. 2008 for example, saw melamine, a component of some plastics, found in Chinese baby milk formula, allegedly leading to about 300,000 cases of illness and several deaths; melamine had been intentionally added to increase the apparent protein content of the powder. Similarly, in the UK, feeding of ruminant animals on cheap recycled rations including reclaimed meat and bone meal, was responsible for the generation and transmission of Bovine Spongiform Encephalopathy in cattle and variant CJD in humans, a health catastrophe that emerged in the late 1980s, and whose implications continue. The cost of BSE at the time was put (by Farmer’s Weekly) at £4.5 billion, plus the emotional cost to victims, and their families. That too must have given impetus to organic production systems that required more careful traceability of food. On the other hand, thousands of people die every year from diabetes and similar diet-related conditions. They are affected by excess consumption of processed foods such as refined sugars and starches, not by eating non-organic food, or though becoming contaminated with toxic substances.

Possibly consumers want to be ‘closer to the soil’ and nature, and there is no doubt that many organic food consumers believe that their food is produced with less environmental damage than conventional farming, and that conventional agriculture receives hidden subsidies that make it appear cheaper to produce than organic, whilst its true cost is hidden.

Let’s return to some of the statements about organic food, and look in more detail at the evidence and the statements made about each aspect.

1. Produced by low input, quasi-natural agricultural systems, less dependent on herbicides and pesticides, and avoiding chemical residues, or on fossil fuels and their derivatives

This is a huge and complex area, and I can only summarise briefly. Taking the last element, all farming uses fossil fuel currently, and the research to establish which systems use most is not, to my knowledge, conclusive even though we do know that synthetic fertiliser production is a major consumer of energy. It might be assumed



that the actual production of organic food uses less fossil fuel if it uses less synthetic fertiliser, but we would have to include transport, processing and storage systems for food as well, and the whole life outcomes are not as clear cut.

Considering pesticides in more detail, as that may be clearer, large areas of single species are not a 'natural' ecological situation, and require some form of intervention if they are to be maintained free of pests such as hungry insects. Tens of thousands of new chemical compounds have been developed since WWII, many used in agriculture. Initially, it appeared that some agrochemicals were actually stockpiled wartime chemicals, humanicides, reformatted into pesticides and used in smaller doses. Pest resistance rapidly developed; today more than 500 insect pest species are known to be resistant to one or more insecticides and conventional farmers are hence encouraged to increase the dose to compensate for weaker performance. The allegation from the organic lobby is that this damages microbial soil communities and earthworm populations, and slows the natural degradation of organic matter. As a consequence, natural populations of pest predators in and above the soil fall, further increasing reliance on chemical intervention to slow attacks on plant monocrops, in an escalating 'agrochemical treadmill'.

In the Guardian newspaper this month, George Monbiot went further, describing an ecological meltdown – 'Insectageddon' – resulting from massive agriculturally-driven declines in bees, hoverflies and other pollinating insects. Monbiot asserts that continuation of this trend of loss of invertebrates would be an ecological catastrophe, where insect-pollinated crops will remain unpollinated because of the unintended consequences of pesticides, and that it is a worse and more immediate existential threat than global warming.

Organic farming systems tend to rely on prevention rather than cure, certainly reducing the use of pesticides, in part by using predatory lace wings and other biological control agents to eat insect pests, rather than synthetic sprays. However many organic certification schemes also permit use of certain pesticides, although the extent of this has waxed and waned over time. For example, copper sulphate was permitted to be used against fungal diseases such as potato blight, which is endemic in the UK, although it was banned after March 2002. In the UK today, no herbicides at all are to be used in organic systems, and there is a rigorous inspection regime. In the USA over 200 chemical additives are allowed, including some antibiotics such as streptomycin on apple trees (until 2014), and others too. However, the traceability of imported 'organic' products is less secure; imported Chinese organic apple juice, for instance, has been found to contain significant traces of pesticides. A major 2002 study by the Soil Association found that half of the UK fresh fruit and vegetable samples tested contained pesticide residues, and that safety had only been established for individual pesticides, not cocktails. A Stanford University study in 2012 found that whilst 38% of conventionally-produced food in the USA had traces of pesticides, 7% of the organic foods also did. So, organic food is not always pesticide free, and indeed some small doses arrive as a result of spray drifting in the air from adjacent non-organic farms. In Canada, between 2011 and 2013, half of organic fresh fruit and vegetables contained pesticide residue, according to Canadian Food Inspection Agency, although only a small number exceeded the allowable levels. 78% of the non-organic crops were similarly affected; most were imported.

Setting aside the issues for soil health, to which I will return in a minute, we must then ask ourselves if this matters for human health? Trying to control nature is certainly a very lucrative business, and perhaps we are allowing a few large chemical companies such as Monsanto and Syngenta to poison us for the sake of their profits? One point of view says that the results of pesticide applications on human health are clear, but they have been withheld, intentionally buried, selectively promoted, or simply ignored - something close to lying.

In terms of pesticides, there are certainly no known safe limits for ingesting these compounds, for example by eating the skin of sprayed vegetables or the husks of cereal grains. The long term effects on health have not been clearly established because it is difficult to do control trials by dosing children with pesticides, and as a consequence we rely mainly on examining the spatial variability of particular exposures and complaints.

There is a plethora of studies suggesting links between pesticide consumption and different ailments. In children, pesticides have been linked to autism and attention deficit hyperactivity disorder, for example. Francis (2012) suggested that ADHD was linked to exposure of organophosphate residues, identified in urine samples.



When children ate organic fruit and vegetables, they had lower amounts of organophosphorus residues in their urine. Pesticide residues have been found in foetal cord blood taken from Canadian babies. There are also reports of excess miscarriages and profound birth defects, and impaired ability in children living in Carolina close to areas where crops were sprayed. Also, Californian women living near fields sprayed with organophosphorus pesticides were more likely to give birth to children with autism spectrum disorders.

Impacts on adult health and wellbeing are also cited. Pesticides are thought to reduce human fertility; some 45 pesticides are hormone disrupters and when they leach into groundwater, rivers and ponds, certainly affect reproduction in fish, snails, alligators, seals and birds, and so may be assumed to impact humans too. A Danish study suggested that women with higher than average levels of the pesticide dieldrin in their blood doubled their risk of breast cancer. Although dieldrin is now banned in the UK for all crops (organic or not), it is persistent in soils and animal tissues. Atrazine and arsenic are also used, and are carcinogenic (Francis, 2012) at very low doses. The US Agricultural Health Society has found links between increased prostate cancer rates and methyl bromide (a fungicide used on strawberries), and many pesticides.

Aldicarb, is a widely used insecticide for citrus, cotton and potatoes globally, and is also is a powerful immunosuppressant which reduces the human body's ability to fight off disease. Listeners may recall that it was this pesticide that was one of those accidentally released at Bhopal, India in 1984, killing thousands and leaving many more chronically ill. Fortunately, aldicarb appears not to accumulate in soil, but it may do so in water. Although banned in the UK and Europe since 2007, it is still allowed in US and Australia. Research by Syngenta, a Swiss manufacturer of pesticides, has suggested that it is safe; rather ironically, aldicarb is banned in Switzerland.

I could continue with the catalogue of issues about pesticides here, but want to add a note of caution in interpreting these findings. Firstly, statistical association does not necessarily imply causality. Secondly, the acute toxicity of all pesticides used today in both organic and non-organic farming is very low. Pesticide residues can now be measured in amounts as little as parts per trillion, well below the allowable levels in any food. Consequently, they are now found almost everywhere we look, whether in organic food or conventionally produced food. Although levels are undoubtedly lower in organic, they are not absent, as some pesticides such as mineral oils, paraffinic oil and petroleum distillates are permitted, and some arrive accidentally in crops, or by fraud. And in 2012, US research said that pesticide consumption on non-organic food is typically less than 5% of the acceptable dietary intake, so further reductions are anyway meaningless. The evidence is not perfect.

Clearly in these situations, who is producing the conflicting 'evidence' becomes crucial. Conflicting statements abound, and conclusions are difficult to draw. The slides show some differing opinions.

In summary, no form of agriculture is 'natural', but caution is certainly justified in the use of pesticides, and organic production has a contribution to make there in reducing risk to human health.

2. Healthier, and more nutritionally balanced than conventionally produced food;

According to Francis (2015), the US Department of Agriculture and scientists elsewhere have been measuring the nutritional value of different foods for more than 50 years and have found significant nutrient declines in all crops in all regions over the past several decades. Scientists disagree on why this is happening, suggesting everything from inconsistent measurement methods to agribusiness' quest for higher yields.

In the UK, the Soil Association suggested in 2002 that organic food contained more nutrients than conventionally produced food, with higher levels of various minerals and vitamin C. They also cited several studies showing more dry matter and less water in organic food, hence more nutrients per unit weight. A 12-year German study showed markedly higher levels of potassium and iron in organic food, and somewhat higher magnesium, calcium and Vitamin C levels. Simultaneously, a US study showed that organic food had 63% more calcium, 73% more iron, 125% more potassium and 60% more zinc, plus 29% less toxic mercury. A carefully-constructed 2008 study by Pennsylvania Department of Agriculture, and Washington State University of 191 matched fields with the same plants, in the same locations, and the same year, suggested that 62% of organic produce contained more nutrients than conventionally grown produce, perhaps because organically grown



plants had more robust root systems which absorbed nutrients more effectively. Conventional systems had higher nutrient levels in 36% of the matched pairs. The average serving of organic food contained about 25% more nutrients.

But again, caution is necessary in interpreting these sorts of results, as many are based on small samples, with inconsistent experimental design. Some published assertions may just be lies by those with interests, as we have seen in other scenarios, and others may be selective with the evidence. For example, a UK MAFF shopping basket study showed greater food value for organic apples and carrots, plus more vitamins in other fruits and vegetables, but there were also effects from different varieties of the same fruit, not necessarily the highest yielding ones. More significantly, the levels of vitamins fell, depending on the length of time the food had been in transit or on the shelf. Another study by Murphy *et al* in 2008 reported on 35 different varieties of soft white wheat, finding that organic crops were significantly higher in copper, magnesium, manganese, zinc and phosphorus, but not iron. The soil contents of these elements were similar, but there were big differences in the mineral contents of between different cultivars, some of which were better adapted to highly organic soils. Organic crops may lose the nutrient advantage if the crop yields are significantly increased, so in future developments it is important that both yield and nutritional quality improvements are sought at the same time.

At the other end of the scale, a 2002 UK Food Standards Agency report chaired by Lord Krebs said that there was no difference in nutritional value between organic and non-organic foods. This view was confirmed by a 2012 Stanford University study by Bravata, showing that organically-farmed foods were not more nutritious than traditionally-farmed food. They analysed 237 rigorously-conducted studies, and with the exception of phosphorus, which humans typically consume in sufficient amounts anyway, found that organic food does not contain more vitamins or minerals. A typical research finding says the following (in this case concerned with the content of selenium) ‘Despite the overwhelming literature dedicated to Selenium - Reilly states that there are possibly 100,000 publications that consider this element following its recognition in 1817 – very little research to date has been undertaken on investigating the element in organic farming systems’ (Arthur, 2008). Little has changed since.

Organic food may therefore help people to avoid synthetic chemicals and additives such as antibiotics (more of that in a minute), but despite the opinions of 51% of USA residents (in 2014, researcher Nielsen cited in Francis, 2015, Organic Food) it is not inherently more healthy.

There is a potential side issue to do with food poisoning. Organic food appears not to have any beneficial impact on food-borne illnesses, although the germs in conventionally-produced meat such as pork and chicken are more likely to be drug-resistant to antibiotics. 2002 Soil Association evidence shows that food poisoning rates for *e.coli*, salmonella and campylobacter have increased across Europe for two decades. The thought that *e.coli* risk is associated with misuse of antibiotics in modern agriculture, increasing immunity. *E.coli* is found everywhere, on hands for instance, and is especially common in uncooked meat. In 2006, 100 Californians became ill as a result of ingesting *e.coli* originating from Natural Selection’s organic bagged spinach. A 77 year-old woman and a 23 month old baby died. However, the organic producers were not deemed responsible as the contamination had come from improper handling somewhere between the field and the plate. 2006 also saw *e.coli* contamination in US organic carrot juice, and peanut butter, including organic peanut butter in 2009, when seven died.

The U.S. Hudson Institute immediately broadcast that the *e.coli* risk was higher in organic food, perhaps because *e.coli* is found in the animal manures used as fertiliser (though they are also used in non-organic agriculture, as is human sewage sludge). Several subsequent studies suggested a higher risk of *e.coli* in organic products, but the vector was subsequently found to be the washing water for the food, compounded by errors in laboratory testing. The Hudson Institute is another agency with a potential interest in the demotion of organic food, as my slides indicate.

Conversely, others have suggested a relatively reduced risk of *e.coli* in organic produce, because of the animal’s natural immunity acquired from grazing outside all year, the heat treatment produced by composting of organic manures prior to use, the reduced levels of *e.coli* in organic plots because of competition from other soil



organisms in a biodiverse setting, and the required storage time for animal manures prior to application to fields. Summarising, there is no more risk from organic than non-organic food.

3. Fresher, and better tasting, with shorter and speedier local supply chains;

We may perhaps dispatch the taste matter quickly, by using our taste test results.....

And whilst in theory our image is of organic vegetables being taken (perhaps by horse-drawn cart, or in a basket?) to a local shop for sale, or sold at the farm gate, much is now transported long distances, including as air freight. It then tends to sit for longer periods on supermarket shelves, or in the processing facilities of internet food suppliers. Moreover, we feed organic chickens on imported organic grain, to secure organic eggs, which again militates against local supply chains. Speedy, local supply chains are largely a myth in today's organic food market.

4. Part of a circular economy with plant and animal wastes, and nutrients, returned directly to the soil;

Reference has already been made to the use of 'natural' animal wastes as fertilisers in organic production systems. This is an inherent part of a 'circular' economic model where food waste is minimised, and any waste agricultural product is returned to the soil, hence preserving and recycling nutrients such as nitrates, and carbon as organic matter, rather than emitting more nutrients to water bodies and air.

Nitrates are an intriguing example, where alternative facts are prominent, and public messages are broadcast in confusing and conflicting ways. Artificial nitrate fertiliser saved the human population well in the past by increasing crop yields, and was lauded. It is a soluble nutrient that increases leaf growth and reduces the need for crop rotations and fallow periods. Originally added as animal waste and maintained by crop rotation using nitrogen fixing crops, supplies then switched to guano (bird waste, mined in small areas of the world and transported thousands of miles), and then to synthesised fixation from atmospheric nitrogen in industrial plants.

Nitrates are problematic in three ways. Firstly, excessive concentrations create eutrophication and toxic algal blooms in watercourses and lakes, creating ecological problems and increasing water treatment costs if the water is to be drunk downstream. Farmers do not pay this cost for extracting nitrates from drinking water, of course, but the situation is now managed in part by the designation of Nitrogen Sensitive Zones around susceptible watercourses. Secondly, excessive nitrate application can enrich soil to the detriment of native flora and fauna, damaging biodiversity. Thirdly, nitrates have been alleged to be toxic to human health if present in high concentrations in food and drink, and the World Health Organisation has expressed concern about 'blue baby syndrome' and cancers. A number of studies suggested that when nitrates are converted to nitrosamines, they may be carcinogenic. However, this latter is contested and a complex issue in its own right.

Organic production, by contrast, focuses on crop rotation with fallow or nitrate fixing crops reducing the need for artificial nitrate addition, and maintaining more constant low levels of the nutrient. Organic crops also tend to have lower nitrate content, hence the suggestion that they are better for human health.

Summarising, organic food production does tend to be a more nearly 'circular' system, even if wastes are not returned to the soil 'directly' as our statement says, but many thousands of miles away. However, conventional agriculture is also moving in this direction, particularly in those areas using anaerobic digestors to generate energy and fertiliser from food and animal wastes, because of high energy costs. The statement may not be a myth, but it may increasingly be applied to all forms of agriculture.

5. Better for animal welfare, with low stocking rates, no antibiotics, access to the outdoors, quasi-natural diet;

Again, this statement requires only a brief treatment. Stocking rates for certified organic animal husbandry are lower than in many conventional systems, and access to outdoors is required. The use of antibiotics is usually prohibited. In more intensive conventional systems, antibiotics are used to reduce infection in stock, and in some cases as growth accelerators. But they do preserve animal's lives.



Over-use is known to promote antibiotic resistant salmonella, as previously mentioned, and MRSA. In some parts of the world, the USA for example, farmers can buy sacks of antibiotics over the counter without prescription, and a survey found that 50% of pork and 20% of beef in Louisiana supermarkets contained MRSA (quoted in Soil Association, 2002). Use is more limited in the UK, even in conventional farming, since a House of Lords Report in 1998 found that routine use in animal food should be banned because they were threatening to undo all their early promises and success in curing disease.

The position on antibiotics, that organic systems are less problematic, is likely to be true, but some animals will nevertheless die if antibiotics are not available.

6. Not damaging the environment, but preserving biodiversity, for example through ‘heritage’ breeds, and plants native to specific bioregions, and avoiding Genetically Modified Organisms (GMOs);

Allegedly pesticides and herbicides reduce the abundance and range of insects, wild plants and seeds, and cause the decline of native farmland bird species, not only in the areas sprayed, but also adjacent and downstream areas. A new study published this month in the peer-refereed journal PlosOne, described a 76% reduction in flying insects in nature reserves in Germany, over the last 27 years. This was attributed to pesticide use and loss of habitat, even though the areas were reserves, and its implications are potentially serious. Biodiversity has been lost, and is being lost.

But by contrast, if all food production were organic, it would almost certainly be necessary to plough up additional land, and destroy large areas of natural ecosystems as there would be little room for unproductive, albeit poor quality (in relation to food production) land. It has been suggested by researchers at Stanford University that without nitrogen fertilizer, we would already have had to plough another 6.6 million square miles of wildlife habitat to feed today’s population, an area almost equal to that of South America. The use of ‘heritage’ species, historically abandoned species but often with lower yields, would also present similar issues. In the UK, to maintain present levels of food production, it might be necessary to extend organic arable production into upland areas of Wales, Scotland, the South West and the Pennines, with consequent loss of amenity. This is a problem currently under review by the National Trust, who have a statutory interest in the preservation of such beautiful landscapes.

8. Necessary to feed the world sustainably, in the long term.

Conventional industrialised farming in areas such as the UK has become very efficient at producing more food per square metre of land, and thus shielding ecologically valuable and scenically attractive ‘wilderness’ areas from being ploughed up. Although in the UK, we can buy our food elsewhere in the world, millions of lives in the developing world also depend on industrialised high input agricultural systems. They need to secure increased food production from areas of arable land that may be reducing through salinization, desertification, urbanisation and erosion, and where water supplies are restricted, to maintain current population levels. Previously, developments in crop production in the so-called ‘green revolution’ enabled their hungry people to be fed, for example by growing short stalk cereals and high yielding rice crops in the 1970s. Despite some barbarities, and largely because of industrialised food production systems, rioting and mass famine did not occur, despite the pundits predictions.

Today, the allegations are that whilst organic food has environmental benefits, it cannot feed the larger global population. Organic yields per hectare generally are lower, perhaps by 25%, although there are contrary assertions that yields have been doubled in some areas through mixed cropping of several rice varieties together, which limits the spread of disease, and that this is sustainable. George Monbiot suggests last month that a recent study in the [Nature Plants](#) journal showed that most farms would increase production if they cut pesticide use. And in places such as Cuba after the withdrawal of Russian food aid in 1989, allocation of community gardens to individuals managed to increase food yields and security there largely using organic means.

Gaps in the research on yields are obvious. In 2002, the pro-organic UK Soil Association could really only cite one six year study, (Reganold, J et al. Sustainability of three apple production systems. [Nature](#) Volume 410, 19 April 2001), suggesting that apples grown organically had similar yields to both integrated and conventional



production, but promoted better soil quality, were better for the environment, were sweeter, had higher profitability, and achieved greater economic sustainability. However, one apple study does not make a pie and the yields data is still contested. Most of the research evidence suggests that organic yields are lower.

However, looking back, if we take the 800 million people in the world that were hungry in 2000, the problem was not the availability of food; food was not in short supply. The grain produced in 2000 could have fed 8 billion people, but it was unevenly distributed, some rotted, and much was fed to animals which are inefficient protein producers. In some areas food was being exported whilst a famine was taking place locally. The main cause of hunger was, and is, poverty and lack of access to land, not shortage of food. Today, we have a curious European phenomenon too, associated with the Common Agricultural Policy where farmers in the northern hemisphere are paid to 'set aside' agricultural land, taking it out of agricultural production to reduce local food surpluses.

However, there are longer term concerns about sustainability, the most significant of which relates to soil erosion. Global Land Outlook in September 2017 asserted that productivity was declining on 20% of the world's cropland. Peter Melchett from the Soil Association, quoted a 2009 UK Government survey saying that intensive farming is jeopardising future food production because we are losing 2.2 million tonnes of topsoil every year through erosion, and that soil organic matter is massively declining. That was in 2009. By 2014, he suggested that we had maybe 100 harvests left. Simultaneously, UN FAO suggested that there were just 60 years of harvest left because of soil damage globally. It is true that soils with higher levels of organic matter, and retaining a growing cover throughout much of the year, tend to lose less volume from wind and water erosion. However the problem is that we do not actually know if soil erosion is more, or less, on organic or non-organic farms, because as far as I know the research has yet to be done.

In conclusion, some of you will recall designer Vivienne Westwood's controversial statement on UK Radio 5 Live in 2014, that people who could not afford to eat organic food, should just 'eat less'. For many, that is not an option.

Organic farming is sometimes presented as a sort of 'holy grail' to problems of food scarcity and environmental damage, but 2017 research from Verena Siefert and Navin Ramankutty, of the University of British Columbia has highlighted that it is only one part of the solution. They and colleagues undertook a systematic review of the 17 main areas of concern about modern farming and the suggested benefits of organic production, all of which I have touched on, and including yields, climate change, ecology, consumer health and so on. For two main areas that I have picked out – pesticide use, and nutritional value, any benefits in an area such as the UK or Canada, are marginal. Beyond that, because yields are typically 19 to 25% lower than under conventional farming, the environmental and ecological benefits of organic agriculture diminish as more land will need to be brought into cultivation. She did not look at taste. I would accept that as a reasonable synthesis of current data – not a lie, and not a misrepresentation of any sort.

Whilst we might welcome organic farming as adding pressure to conventional farming to reduce inputs of fertilisers, pesticides and herbicides, and to pay attention to other environmental issues as well, we will not in my view be able to feed ourselves for the future if we demand solely organic produce. Nor would that, in my view, be advisable for other reasons.

We need, in my view, to think much more carefully about the carbon implications of all farming practices, including organic farming. I was interested to read in the Observer four or five days ago, about a Dutch egg producer who claims that his non-organic production methods are not only environmentally sensitive and attentive to animal welfare issues, but carbon neutral. He has solar panels, a slightly reduced space per bird, but a greatly increased yield in terms of space and cost, and reduced inputs of raw materials. He is part of a local circular economy, and his chickens mainly eat local bakery waste - broken biscuits and suchlike. The article did not say if they were organic biscuits.