



Everything is Connected to Everything Else

101 stories about 21st century Geography

by

CARL LEE

CHAPTER 5

FOOD AND WATER

CHAPTER 5: FOOD AND WATER

They eat what?

It took me a little while to realise what the deep-fried snacks being hustled by the Bangkok street vendors were. They were crickets, or grasshoppers, or locust. Not being an entomologist I was not entirely confident of my ability to identify exactly what type of insects they were. I was more certain about food offered on a railway platform in deepest urban China. Chicken feet: claws and all. Again deep-fried.

I shouldn't have been surprised about the chicken feet. Earlier on in that same visit to China I mistook a restaurant in Guangzhou for a pet shop. A forlorn looking pangolin flinched in a cage: a super rare, Red Data Book species awaiting the moment when it became somebody's dish of the day. Or maybe I should have tried kitten or monkey – there was a fair range of choice. Never have I felt more vindicated being a vegetarian, although on that railway platform, after a daily diet of cabbage

and cabbage (and of course rice) and with no other food seemingly available, the chicken feet were vaguely tempting. After all it is rumoured that the Scots have proved that anything deep-fried has a certain primal palatability.

In our world it is estimated that two billion people eat insects as a regular part of their diet. With an increasing global population and also a greater proportion of the human diet being made up of protein, it looks like the job of an entomologist will expand beyond working out ways to control and kill insects towards ways of raising and cooking insects. You may scoff at this scoff but the Guardian newspaper in August 2013 reported Fortnum and Mason to be selling ant lollipops and scorpion toffee.¹

The Food and Agriculture Organisation of the United Nations has looked at the potential of insects as a significant part of the global diet.² They set out a range of environmental benefits to increasing the consumption of insects:

¹ Baker, T (2013) 'Grub's up: can insects feed the world?' The Guardian 5 August 2013. Access at <http://www.theguardian.com/lifeandstyle/2013/aug/05/can-eating-insects-feed-world>

² Van Huis, A et al (2012) 'Edible Insects: future prospects for food and feed security.' Food and Agriculture Organisation United Forestry Paper 171. Access at <http://www.fao.org/docrep/018/i3253e/i3253e.pdf>

“The environmental benefits of rearing insects for food and feed are founded on the high feed conversion efficiency of insects. Crickets, for example, require only 2 kilograms of feed for every 1 kilogram of bodyweight gain. In addition, insects can be reared on organic side-streams (including human and animal waste) and can help reduce environmental contamination. Insects are reported to emit fewer greenhouse gases and less ammonia than cattle or pigs, and they require significantly less land and water than cattle rearing.”³

What we eat evolves as part of wider human culture and over time large changes have occurred to diets. The evolution of humanity from apes to humans has been partly associated with the use of fire to cook food and thus make it more digestible.

Then there is the development of agriculture five to six thousand years ago when we moved on from what we could catch or forage to thinking about what we could grow and husband. Then as we got better at agriculture we discovered how to breed more useful, tastier and higher yielding plants and animals. A better diet meant greater cognitive and physical development. When humans started to travel widely beyond their local environs - with the intention of returning home – more often than not what was most interesting in their spoils of exploration were the foods and flavours they discovered.

An example of this is the introduction of the chilli pepper to the cuisine of the Indian sub-continent. Chilli is synonymous with the Indian ‘*curry*’ but until the arrival of Portuguese explorer Vasco de Gama in 1498, in what is now Goa, the heat that titillated the taste buds of India was derived from black pepper whose indigenous home is the rainforests of Kerala in the south of India. It was an excellent culinary swop - black pepper for chillis – and such trades were the basis of much of the embryonic global trade system that developed from the 15th century onwards. The return of the spice ships was a much awaited event in Lisbon, London and Cadiz. Of course the Portuguese had acquired chillis from their travels to the Americas. The great trading nations, from the 14th century onwards, shuffled animals, birds and plants across the surface of the world.

It is therefore a little surprising given all that global mixing up of food that when, in 2007, the lens of American photojournalist Peter Menzel was trained on the food consumed in a week by 30 families scattered across the world there was so much variation in these families’ diets.⁴ Of course, the variation is as much about wealth as culture. The Sudanese family living in a Chadian refugee camp survive on meagre rations costing no more than \$1.23 a week whilst a staggeringly thirsty German family stand guard over \$500 of every possible

³ Op cit page 16.

⁴ Menzel P and D’Auisio F (2007) ‘Hungry Planet: What the World Eats’.

food group bar insects. However a few foods show a degree of ubiquity: bread, bananas, pizza and Kellogg's breakfast cereals. The Sudanese family eat none of these and probably wouldn't turn their noses up at insects.

Our ability to access food is determined by the resources we control and can utilise. In developed and predominantly urban societies this is through the money economy. In less developed rural societies this is largely determined by the natural raw materials at your disposal. In the world today some 850 million people – 12% of the global population – are undernourished.⁵

Ethiopian dawn.

“Dawn – and as the sun breaks through the piercing chill of night on the plain outside Korem it lights up a biblical famine, now, in the 20th century. This place, say workers here, is the closest thing to hell on earth.”⁶

When in October 1984 Julia Somerville, a BBC TV News reader, introduced Michael Buerk's report from Ethiopia on an unfolding famine spreading across that drought and war ravaged land she was probably unaware of the historical significance of the moment. Buerk is sparing in his prose; he lets the camera talk. Sitting rooms all over Britain bore witness

to something that looked beyond medieval. Tears became anger and anger became action. A nation woke up to the realisation that not only were human obscenities being enacted in their world as a result of a lack of food, but also that they could do something about this.

A belligerent Irishman by the name of Bob – with an extensive address book containing the names of some of the world's most famous, and rich musicians – galvanised a generation into giving a toss.⁷

Live Aid wasn't the first attempt at marrying music to social compassion on a global scale. 1971 saw the George Harrison organised Concert for Bangladesh, which raised awareness and emergency funds to support refugees from the 1970 Bhola cyclone, and a bitter civil war that together had enacted a cataclysm upon this embryonic country.

Live Aid raised an estimated £150 million, a few notches up from the £250,000 raised by the Concert for Bangladesh. One of the most effective tools employed was an edit of the images of Micheal Buerk's BBC News report, accompanied by the song 'Drive' by the American band The Cars. I show this to students but with some care. It still has the power to bring tears to my eyes and some students simply break down. It is a very quiet classroom afterwards. Try it yourself courtesy of YouTube.⁸

⁶ Text from Micheal Buerk's 23rd October 1984 BBCTV News report on the Ethiopian famine. Access the full report courtesy of YouTube at http://www.youtube.com/watch?v=XYOj_6OYujc

⁷ Live Aid 13th July 1985.

⁸ There are a number of version of this online. Try this version <https://www.youtube.com/watch?v=QhXYpXumuA0>

“Who’s gonna pick you up, when you fall. Who’s gonna hang it up, when you call. Who’s gonna pay attention, to your dreams. Who’s gonna plug their ears, when you scream. You can’t go on, thinking, nothing’s wrong.”⁹

Then the good news.

Since 1990 the percentage of the global population who are defined as ‘under-nourished’ – and this is a very low benchmark barely enough to survive on – has fallen from 18.6% in 1990 to 12.5% in 2012.¹⁰ That is with 5.2 billion people in 1990 and just over 7 billion in 2012. According to the World Health Organisation (WHO) there is not a single region of the world that has not seen per capita food consumption (measured in Kcal per day) increase. Globally this has been from 2,655 Kcal in 1985 to a projected 2,940 Kcal in 2015.

Accepting that WHO data is accurate and that UN population predictions for 2015 are fulfilled (7.208 billion) the reality is that between 1985 and 2015 the amount of absolute available global nutrition (not including wastage) has risen by 65% although the per capita increase is lower, at 10.7%.¹¹

To maintain current levels of nutrition to a population of 10 billion that may be reached sometime in the far reaches of the 21st century additional nutrition to the value of 8,208,480,000,000 Kcal will be required.¹² How this will be achieved is one of the great challenges of the 21st century.

Of course average dietary energy requirements are variable between places and over time. Currently the Food and Agriculture Organisation (FAO) calculates that 2,248 Kcal is the average dietary energy requirement (ADER). This has risen from 2,168 Kcal in 1990. People are bigger. Furthermore, this same ADER figure varies between 2,096 Kcal in Angola and 2,544 Kcal in Germany. Germans are bigger than Angolans.

So although in aggregate globally we have seen a significant decrease in hunger in the last 25 years the challenges that face us are as great in the future. These will all have to be met within a rapidly changing environment and its consequential impacts upon agricultural productivity. It is easy to see how scientists are turning their attention to a wide variety of solutions, insects included.

⁹ Lyrics from The Cars ‘Drive’ Written by Bric Runga Lyrics © Warner/Chappell Music, Inc., EMI Music Publishing

¹⁰ All nutrition data from FAO : Food security indicators. Access at <http://www.fao.org/economic/ess/ess-fs/fs-data/en/>

¹¹ This figure is derived from using WHO nutrition data and UN population data to calculate percentage increases in overall Kcal consumption.

¹² Calculated by multiplying additional population of 2.792billion with 2015 global level of nutrition.

That's convenient.

The Food and Agriculture Organisation (FAO), an adjunct of the United Nations, published its 2012 report *State of Food Insecurity in the World* with a very strong focus on chronic hunger in developing countries. But within its datasets it also identifies 16 million people living in the developed world who are also afflicted with chronic hunger. Chronic hunger is not the norm for a country like Britain. We are now a country where 25% of the population is obese – an increase from 14% in 1993.¹³ The NHS report that revealed this data in 2012 substantially attributed this increase to “easy access to cheap, high-energy food that is often aggressively marketed to people.”¹⁴

When it comes to food we live in an age of plenty.

In early 1994 I recall reading a story in a local Bedfordshire newspaper about some Russian women visiting Britain who burst into tears when they entered a local Tesco supermarket in Leighton Buzzard because of the abundance of food on offer.¹⁵ Such stories are perhaps urban myths loitering around our consciousness in the same way that stories of westerners coming to Russia in the 1960s and being ecstatic about the

glories of communism probably did the rounds in Omsk and Donetsk sometime prior to the fall of the Berlin Wall.

This story had resonance for me at the time as the year previously I had travelled through Russia on the Trans-Siberian railway which was a most effective slimming course. A good vegetable shop in Moscow at that time might stretch to three types of vegetable, all in pretty poor condition. Bread was a struggle to find although Mars bars were just finding their way to every news stand and the easiest thing to acquire appeared to be vodka. Food was a daily struggle in Russia and at that time nothing was convenient.

In 1957, when the UK Office of National Statistics (ONS) first produced a comprehensive survey of household spending they found that the mean average for household income spent on food was 33%. Food rationing, introduced at the beginning of 1940 with the onset of war had ended in 1954.

By 2006 the amount of income households spent on food had fallen to 15%. We spend a slightly smaller proportion of our income eating out today than we did in the 1950s (3.1% down to 2.8%). Inversely the amount spent on housing had more than doubled over the same period.¹⁶ Intriguingly cigarettes were the number one consumer expenditure in 1957. By

¹³ Latest obesity statistics are from the Health and Social Care Information Centre. Their 2012 report was widely reported. See <http://www.nhs.uk/news/2013/02February/Pages/Latest-obesity-stats-for-England-are-alarming-reading.aspx>

¹⁴ Op cit

¹⁵ I have searched high and low for this story. It was, I think, in the Beds and Bucks Observer sometime in 1994. However I have since heard similar stories, variations upon this theme, maybe it is one of those ‘urban myths’ that gets recycled through society.

¹⁶ Office of National Statistics Family spending 2006 January 2008. Access at <http://www.ons.gov.uk/ons/search/index.html?newquery=Family+Spending+Celebrates+50+years>

2006 they had fallen to 30th place. Clearly a huge change has occurred over 50 years in respect to our socio-economic relationship to food (and cigarettes).

The change in food shopping over 50 years in the UK has been driven by three key themes: product choice, convenience and oligopolistic capitalism. First the choice. Well even somebody such as I can bore young people with what we considered to be sophisticated foods in the 1970s: tinned peaches, Vespa curries, canned chunky chicken in white wine sauce, Angel Delight and dried pasta. Oh yes we lived off the fat of the land.

Today I have four large – and these really are large – supermarkets within a 10 minute drive of my house: Tesco, Sainsburys, Waitrose and Morrisons. There you have oligopolistic capitalism. Add Asda and the Co-op (both within 10 minutes but only medium sized supermarkets) and those 6 retailers account for 70% of all grocery sales in the UK.¹⁷ The convenience part is accentuated by the fact that having a supermarket the size of a small town centre is not sufficient for Tesco and within 5 minutes of my house by foot I have a Tesco ‘local’ store. Actually I have local Morrisons and Sainsburys even

closer. Some of these stores rarely shut. If I want to mooch on down for a yogurt at 3am – no problem – I’ll have a choice of hundreds of different products to browse through. My every whim, as far as food is concerned, can be sated as long as I possess the economic wherewithal and don’t want fresh durian in the middle of the night.¹⁸

In cultures where the acquisition of food is not convenient people develop a different relationship with food. Kenneth Good was an anthropologist who between 1975 and 1987 lived with the Yanomami people deep in the Venezuelan Amazon. He initially set out to study the food resources of the tribe in order to ascertain their motivations for inter-village conflict. He discovered warfare was not motivated by scarce food resources but by the desire to improve reproductive success – sex. Testosterone was always the original chemical weapon in warfare.

Good was a man who immersed himself in his work, he ended up marrying Yarima, a Yanomami tribeswoman, and they had three children together. When the family moved to the USA their eldest son, David, reflected

“In the Amazon, food takes time to hunt or grow. It is never wasted or refused. ‘Are you hungry?’ is a question without meaning. You might as well ask a person if he cared

¹⁷ DEFRA Food Statistics Pocketbook 2012. A treasure trove of facts about the British and their eating habits.

Access at <http://webarchive.nationalarchives.gov.uk/20130103014432/http://www.defra.gov.uk/statistics/files/defra-stats-foodfarm-food-pocketbook-2012-121005.pdf>

¹⁸ Durians are a most bizarre fruit from south-east Asia, whose smell is a bit farm yard like- an extremely acquired taste

to breathe air. So the experience of a supermarket, in which an almost limitless amount of food sat, ready-picked and plucked, or of restaurants, where one was presented with a choice of what to eat, made the world feel upside down.”¹⁹

What the Good family attempted to reconcile were two cultures. For one food had real value, cultural, spiritual and social but also carried a degree of risk to secure. The other food culture, in America, was about meeting – in fact creating – desires that could be fulfilled at least with no immediate risk and as conveniently as possible. Yarima returned to the rainforest after a few years, her children stayed with their father in America.

Some customs must seem strange from whatever cultural perspective you look at them. In July 2013 the 181 year old embalmed corpse of British philosopher Jeremy Bentham was brought out of his storage cabinet in order to attend a board meeting of University College London.²⁰

Bentham was the philosopher who set in motion the idea of utilitarianism – whereby rational human behaviour was to maximise utility (pleasure) whilst minimising pain and suffering. What Bentham would have made of our ability today to accentuate our pleasure with food of diversity and quality with

so little pain (obesity aside) is something to consider. We eat better and live longer than in his day.²¹ Bentham was a thin, dapper man. At least he was when he died.

Of course it isn't just about food, convenience is everywhere. A most startling example is the ability to buy just about any illegal drug and have it delivered to your door via the Silk Road website. It isn't quite Tesco online, you will need a proxy server, to invest in some Bitcoins and have sussed out a browser called Tor but every one of these things you can do sitting on your backside with the curtains drawn. Although those too stoned to realise, or care, miss the point that Silk Road has a political agenda. Silk Road's anonymous owner *Dread Pirate Roberts* was conveyed a modicum of respectability by being interviewed by global wealth magazine *Forbes* in August 2013. The magazine set out their interest in Dread Pirate Roberts by describing him as “a radical libertarian revolutionary carving out an anarchic digital space beyond the reach of the taxation and regulatory powers of the state.”²² Just their sort of guy.

¹⁹ Kremer W (2013) 'Return to the rainforest: A son's search for his Amazonian mother'. BBC News Magazine 29. August 2013. Access at <http://www.bbc.co.uk/news/magazine-23758087>

²⁰ This is a case of truth being stranger than fiction. See with your eyes at <http://metro.co.uk/2013/07/12/181-year-old-corpse-of-jeremy-bentham-attends-ucl-board-meeting-3879586/>

²¹ A good perspective on this comes from Seebom Rowntree's 1901 study 'Poverty: A Study of Town Life'. In it he records the diet of 18 working class families in York in the late 19th century. They are often hungry.

²² Grenberg A (2013) 'Meet The Dread Pirate Roberts'. *Forbes Magazine* 14. 8. 2013.

Access at <http://www.forbes.com/sites/andygreenberg/2013/08/14/meet-the-dread-pirate-roberts-the-man-behind-booming-black-market-drug-website-silk-road/>

Dread Pirate Robert's brand of libertarian capitalism was, it turned out, a little too strong for the United States government. At the beginning of October 2013 the FBI arrested a 29 year old man called Ross William Ulbricht and accused him of being the mastermind of Silk Road. The Feds had got their pirate. One suspects that the idea itself remains unarrested and awaits a new libertarian swashbuckler to put it back on the digital high seas.

Although lives of hyper-convenience inhabit a country like Britain, in much of the rest of the world they are only just beginning to be felt and then only by an emergent middle class elite in major cities. Many countries lack the transportation and storage infrastructure to sustain a complex food chain structure. Each year in India, enough food to feed 70 million people for a day rots in poorly maintained warehouses managed by the government.²³ The sophistication of developed world distribution structures for food exist because relative energy costs for transport and storage are so low. Where storage, transport and logistics are limited, food economies are predominantly local in nature.

We can bring you wine from Australia that costs less in a British supermarket than an Australian one. You can have fresh flowers from Kenya and asparagus from Peru: tropical fruit in January and perfectly ripe bananas all year round. It is all so very convenient. Our plate runneth over.

Throw another steak on the barbie.

Carlos Menem, president of Argentina between 1989 and 1999, has been variously reported as suggesting during an interview with an American news magazine "to tell your readers don't come to my country if they are vegetarian."²⁴ His was a zeitgeist boast as, although you could hardly claim the Argentineans had embraced Linda McCartney ready meals, with a mighty 129lbs of beef consumed per person in 2012, there was something dimming the charcoal on the nation's barbecues.

For a country that has more head of cattle than people Argentina is experiencing a decline in beef production and consumption.²⁵ One reason was greater demand from China for animal feed resulting in many ranches being turned over to soya production; another reason was the increasing cost of beef to the average Argentinean and finally even these committed carnivores were widening their diet, vegetarian restaurants were opening in Buenos Aires: the capital city of Argentina has as many pizzerias as steak houses.

²³ Bhalla N (2013) 'Enough grains for 70m Indians rot due to poor storage: report.' Reuter 27.08.2013 Access at <http://www.trust.org/item/20130827061145-onqu5/>

²⁴ Romero S (2013) 'Argentina falls from its throne as king of beef.' New York Times 14th June 2013. Access at <http://www.nytimes.com/2013/06/14/world/americas/argentina-falls-from-its-throne-as-king-of-beef.html?pagewanted=all>

²⁵ 40 million people share Argentina with 51.2million head of cattle.

And they are not alone. Australia has seen a significant decline in the consumption of beef from a peak of around 154lbs a year per person in 1977 to 75lbs in 2010.²⁶ The reality is that beef isn't being replaced with rice and lentils but with chicken and pork. Furthermore the story of one country is not the story of another and globally the consumption of meat has expanded significantly but unevenly.²⁷

Global meat protein consumption per capita has risen from 49lbs in 1961 to 107lbs in 2009.²⁸ Nearly all of this increase has been in farmed fish, chicken and the world's favourite meat – pork. The growth in meat consumption has been driven by the fast developing countries of Asia particularly China. Kentucky Fried Chicken franchises in China have grown from one in Beijing in 1987 to 2600 in 2009.²⁹ I was shocked when I saw the big M next to Mao's mausoleum in Beijing in 1993. Now it is but one of thousands. Capitalism has come to China through fast food. It is the global trade in food that has – since the 15th century – brought the world closer together.

The future of meat consumption has important implications for many areas of the global environment. It tends to be energy intensive, with a general figure of about 7kg of grain required to produce one kilo of beef (this may vary upon the type of beef cattle and how much they are fed on grass). Then there is the water. It takes 15,415 litres of water to produce 1kg of beef.³⁰ There is a significant issue around the management of waste.

Already meat production is gearing up to the challenge with super-intensive livestock production rolling out across the world. Even in the bucolic world of BBC Radio 4's long running farming drama *The Archers* a new industrial super dairy unit is being stocked with over a thousand cows that will never see a field, their not inconsiderable waste being consumed by a bio-generator to power the unit. You can learn a lot about the tensions of modern farming and church flower arranging by listening to *The Archers*.

²⁶ The Australian Chicken Meat Industry: An Industry in Profile' Access at http://www.chicken.org.au/industryprofile/page.php?id=4.4_Consumption

²⁷ Pereltsvaig A (2013) 'Global of Geography of Meat (and Fish) Consumption.' March 15th 2013. Geocurrents. Access at <http://geocurrents.info/cultural-geography/culinary-geography/global-geography-of-meat-and-fish-consumption>

²⁸ Earth Policy Institute and FAO graph accessed at <http://www.treehugger.com/green-food/rising-meat-consumption-takes-big-bite-out-grain-harvest.html>

²⁹ China.org.cn (2009) 'KFC's expansion plans undeterred by economic crisis.' Access at http://www.china.org.cn/business/2009-06/17/content_17963726.htm

³⁰ The Guardian datablog. Access at <http://www.theguardian.com/news/datablog/2013/jan/10/how-much-water-food-production-waste>

If the predictions of the UN's FAO are to be accepted, and I guess they are as expert as anybody, then we will be consuming two-thirds more animal protein in 2050 than we are today. FAO go onto comment that such an increase cannot be met by simply upping the number of animals farmed but that:

"...increases in production will need to come from improvements in the efficiency of livestock systems in converting natural resources into food and reducing waste... a number of additional challenges must be confronted as well, including drought, water shortages and other climate-related impacts – not to mention the threat of animal diseases, some which may directly threaten human health."³¹

By any measure the less meat that people consumer per capita there will be a reduction in the strains upon the wider environment. Obviously we are not going to be a vegetarian world but we will have to realise we are omnivores and have always adapted our diet to fit in with environmental constraints. Even the Australians are adapting with 5% of the population claiming to be vegetarian.³²

The plant collectors.

The Bengali novelist Amitiv Ghosh is interested in how people and places and history and geography are connected.³³ He is a master storyteller and a compelling literary geographer, although he does not claim such a description for himself.

Amitiv Ghosh's as yet unfinished Ibis trilogy weaves a complex fictional tale of intrigue and adventure in the trade frontiers of Britain's early 19th century empire.³⁴ Central to the story is the opium trade from Bengal to China upon which many a respectable British fortune was made whilst millions of Chinese died. Weaving in and out of the array of characters in the books are the plant collectors who at that time pursued plants in all corners of the accessible world in order to exploit their potential economic benefit.

"It was well known, said Sir Joseph, that the gardens at Kew possessed sizeable collections of plants from some of the remotest corners of the earth. But there was one region which was but poorly represented there, and this was China."³⁵

³¹ Food and agriculture Organisation of the United Nations. Press release 14th December 2011. 'Major gains in efficiency of livestock systems needed.' Access at <http://www.fao.org/news/story/en/item/116937/icode/>

³² The Vegetarian Society of Queensland Survey 2010. Access at <http://www.scribd.com/doc/26880337/APF-VWSQ>

³³ Mahmood Kooria (2012). 'Between the Walls of Archives and Horizons of Imagination: An Interview with Amitav Ghosh'. Itinerario, 36, In this interview Ghosh talks about his fascination of inter-connected worlds and the lives that weave places together

³⁴ Ghosh A (2008) Sea of Poppies and (2011) River of Smoke. The third part of the trilogy will be published in 2014.

³⁵ Ghosh A (2011) River of Smoke. John Murray London page 107

And it is true the 121 hectare gardens at Kew has the world's largest collection of living plants and although it is within a novel it is also true that Sir Joseph Banks was perhaps the greatest of all the imperial plant collectors. However although Banks was instrumental in the development of our understanding of the flora of the Pacific Northwest, the South Pacific, Brazil and particularly Australia, he was unsuccessful in penetrating the floristic mysteries of China. So much Amitiv Ghosh gets historically correct within his literary imaginings.

To some extent Banks was an original geographer. Born a minor aristocrat and educated at Eton he left Oxford University without graduating. At 23 he joined an expedition to Newfoundland and then after ingratiating himself with King George III found himself as the botanist on James Cook's Endeavour, whose arrival in what is now Australia was a seminal act on the journey to British imperial power. The voyage took the western route to Australia via Brazil, Tahiti and New Zealand arriving in Botany Bay on the east coast of Australia in October 1770. Banks was 27.

He collected the first plant specimens to leave Australia and he delivered them to Kew Botanical Gardens in London. Later in his life he became the director of Kew. Banks has islands, a peninsular and even a Sydney suburb named after him as well

as 80 species of plant. Pleasingly he also became a leading light of the Dilettante Society which by some accounts was "a club, for which the nominal qualification is having been in Italy, and the real one, being drunk."³⁶ Although this society was chiefly concerned with promoting classical education and the Latin language – something useful to botanists pissed or not. A sober picture of Banks hangs in London's National Gallery: in it he is standing beside a large wooden globe.

It has always been a strange aspect of the British character – if one can make such generalisations - that gardening and botany have played, even today, such a significant part in our lives. Two-thirds of Britons actively maintain their own gardens spending between them some £7.7billion a year.³⁷ We even host what is the equivalent of the gardening Olympics each May in Chelsea. We are a serious gardening nation.

This interest in plants, although clearly with economic undercurrents, is what spurred on the establishment of botanical gardens across the British Empire. I have visited many from Sydney to Singapore. Kolkata (Calcutta) is a personal favourite of mine.³⁸ It is easy to imagine being stalked by a Bengal Tiger whilst you saunter through a treasure trove of tropical plants. Cobras are not an uncommon hazard for its gardeners. It was created in 1787 by The East India Company to collect economic species of trees and spices.

³⁶ Horace Walpole, quoted in Black J (1985), 'The British and the Grand Tour.' (1985), p120

³⁷ HSBC (2011) '37.7 billion cost of maintaining British gardens.' Access at http://www.newsroom.hsbc.co.uk/press/release/77billion_cost_of_maintaining

³⁸ Since 2009 called Acharya Jagadish Chandra Bose Indian Botanic Garden.

By the time Ghosh, in *Sea of Poppies* fictionally imagines Calcutta's Botanical Gardens – through the character of Pierre Lambert the French assistant curator – they had been up and running for nearly 50 years. A more academic appreciation of the impact of Calcutta's Botanical Gardens is provided by Richard Axleby in his paper 'Calcutta Botanical Garden and the colonial reordering of the Indian environment'.

“Underpinning botanical science's pre-eminence was the extension of European power around the world: the activities of plant collectors were intimately tied into colonial expansion, facilitating rule practically and ideologically. In India those who practised botany could find themselves implicated in political intrigue and environmental espionage. Gardens of science were also the nurseries of Empire.”³⁹

Of course moving plants around the world is not always a smart thing to do. Japanese knotweed is a common problem in my neighbourhood and we can blame a certain Dutchman – Phillipe von Siebold – for introducing it to Europe in 1829. It is invasive and then some; he just thought it was an ornamental plant. Or how about the Rhododendron scourge of Snowdonia National Park in Wales or the pretty and tactile Himalayan Balsam which is starting to choke many a British river bank?

In the USA it has been estimated that the economic cost of damage caused and the control of alien invasive plant species runs to \$25 billion.⁴⁰ You need to set that against the benefits that all this botanical push and shove has bought to many parts of the world. Tea being the first one that comes to mind, especially after an afternoon gardening.

³⁹ Axleby R (2008) 'Calcutta Botanical Garden and the colonial reordering of the Indian environment'. Archives of natural history 35 (1): 150–163. 2008.

Access at http://eprints.soas.ac.uk/7618/1/AHN_FINAL_PUBLISHED_ARTICLE.pdf

⁴⁰ Pimentel, D. Zuniga R and Morrison D (2005). 'Update on the environmental and economic costs associated with alien-invasive species in the United States'. Ecological Economics 52 (3): 273–288.

Access at <http://www.sciencedirect.com/science/article/pii/S0921800904003027>

Time for tea.

Camellia sinensis, or tea as most know it, has a history integrated with the growth of empire: Chinese and British empires. That tea is such a cultural signifier for Britain is an object lesson in the fact that culture can evolve rapidly to seem as if things were always so. Tea only became the perennially popular drink of all social classes in Britain after its price fell to that of an affordable staple and that wasn't until the 1850s.

Two Scottish brothers buried in the Christian graveyard of Tezpur, a city clinging to the banks of the Brahmaputra River in the north-eastern Indian state of Assam made it affordable. The Bruce boys, Robert and Charles, were typical adventurers of their time (the first half of the 19th century): fighting with the French, commanding gun boats, spreading the word of the Bible and collecting plants.⁴¹

Robert stumbled onto an indigenous camellia bush in Assam that looked like tea, smelt like tea and when it arrived on the desk of the curators of Calcutta Botanical Gardens was confirmed as tea. Until then it was thought the only place in the world where tea grew was China and it was jealously guarded and expensively traded by the Chinese Emperor. To pay for this desirable export the British had dreamt up the ruse of selling huge amounts of opium to China so they didn't have to use

up their store of gold and silver, the only currency the Chinese would trade in. By 1830 the British East India Company were exporting 10,000 cases of opium a year to China but still the price of tea remained high but not as high as the price being paid by millions of Chinese opium addicts.⁴²

Charles Bruce realised the issue perfectly stating in 1840:

“The difficulty of carrying on dealings with China, which seems to be always increasing, has of late years led to an anxious discussion of the possibility of obtaining tea from a different source.”⁴³

Calcutta's Botanical Garden did the science bit breeding the tea plant into a cultivar and hybridising it with Chinese plants to produce a crop that first spread through India stopping at places like Darjeeling and the Nilgiri Hills before spreading out to Africa.

Joseph Dalton Hooker, another of the geographically important Victorian botanists and a personal friend of Charles Darwin said of Calcutta's Botanical Garden that “Amongst its greatest triumphs may be considered the introduction of the tea-plant from China.” He went on: “the establishment of the tea-trade in the Himalaya and Assam is almost entirely the work of the superintendents of the gardens of Calcutta.”⁴⁴

⁴¹ The story of Charles Bruce can be found at http://epiphanychurchtezpur.hpage.co.in/charles-alexander-bruce_23661083.html

⁴² A brief but accurate account of the British trade in opium to China can be found in the online Britannica Encyclopaedia. Access at <http://www.britannica.com/EBchecked/topic/430160/opium-trade>

⁴³ 'Mr Bruce's Report on Assam Tea'. Chambers Edinburgh Journal Saturday January 25th 1840.

⁴⁴ Dalton Hooker J (1854) 'Himalayan Journals or Notes of a Naturalist, vol 1'. Kew Botanical Gardens p. 5.

By 1850 Assam had become the biggest exporter of tea to Britain. Its price had fallen so much that it increasingly became the drink of choice of the industrial working classes. China on the other hand had been destroyed by the British government sanctioned opium trade, a trade they defended with more vigour than any Columbian cocaine cartel, openly fighting two wars to ensure that their trade and profits continued to grow. It was free market capitalism at the barrel of a gun and through the hypnotic smoke of the opium pipe. Many fortunes still enjoyed by economically successful families in Britain today were built upon their ancestors being, at that time, the world's most successful drug dealers.

Both tea and opium were natural products in that they had been created only through selective breeding over time. Today the crops and even the animals that feed our hungers are increasingly likely to come from a laboratory rather than the diligent and adventurous exploring and exploitation of the multitudinous bounty of biodiversity.

The appliance of science.

Of course the great leaps forward in the selection, breeding and cultivation of plant and animal species over time was science in action: observation, experiment, replication, dissemination. Quite imprecise science in practice as much of it was based on a 'let's try this and see what happens' approach. It may not have been written about in peer reviewed journals or formalised in a body of scientific knowledge managed by the world's leading universities but these slow, meandering steps forward since man first developed agriculture 6,000 years ago have shaped the world in which we live.

What will shape the world of the future is now being imagined and engineered in science laboratories across the world. Why? Well environmental writer Mark Lynas summarised it clearly in a speech to the Oxford Farming Conference in January 2013:

And this is the challenge that faces us today: we are going to have to feed 9.5 billion hopefully much less poor people by 2050 on about the same land area as we use today, using limited fertiliser, water and pesticides and in the context of a rapidly-changing climate.⁴⁵

Lynas is a *bête noir* of the anti genetically modified organisms (GMO) campaigners because he has recanted his active support of them to become a prominent advocate for GMOs as a way of addressing the challenge that he sets out. He hangs

⁴⁵ Access at Mark Lynas's homepage. <http://www.marklynas.org/2013/01/lecture-to-oxford-farming-conference-3-january-2013/>

this off a simple idea, whilst trying to convince the world of the veracity of climate change by continually stating ‘look at the science.’ He realised that when you applied this to GMOs most – but not all – of the peer reviewed science did not propound a future of ‘Frankenstein foods’ and irreparable damage to the biological fabric of life. GMOs were maybe the solution rather than the fear.

Here was a contradiction lying deep in the psyche of the modern western environmental movements. Science was good when it agreed with you, but bad when it didn’t. Think homeopathic medicine. However unlike the scientific debates about climate change (broadly speaking it’s real, we caused it) the science surrounding GMOs is not absolutely nailed down – although generally it lies more in Lynas’s favour .

The socio-political and economic context of the development, dissemination and consumption of GMO food is an emotional, passionate and often polarised debate. It is about the nexus between big business and academia as well as touching on fundamental philosophical positions about the relationship between humans and their environment.

An interesting perspective is provided by an aged Indian scientist Professor M S Swaminathan. He has been a staple of my teaching for decades.

Swaminathan was born in southern India in 1925, an extremely able young man; he rose to become a PhD plant geneticist at Cambridge University. This was just the beginning of a remarkable life that has seen him at the forefront of not only the green revolution that enabled India to become food self-sufficient within a couple of decades of the 1960s, but also leading campaigns for gender equality, sustainable economics, permaculture, organic farming – and here is the surprising bit – the use of GMOs.

Swaminathan is the practical possibilist’s practical possibilist. He has set up the a bio-village project in his home Indian state of Tamil Nadu to improve the economic and environmental wellbeing of the rural poor.⁴⁶ Bio-villages are an example of holistic development based around societal equity and environmental sustainability. In his search for social, gender, economic and environmental equity Swaminathan is prepared to engage with all possible solutions. He marries an organic approach to the hard science of GMOs. He has put his own money where his mouth is and used the prize money of academic awards to fund his own institute in Tamil Nadu engaged in holistic solutions to rural poverty. He has little time for western environmental pressure groups and follows the line of thinking expressed by green revolution colleague and

⁴⁶ Full details of the bio-village approach can be found on the website of M.S.Swaminathan research Foundation. Access at <http://www.mssrf.org/>

Nobel Peace Prize winner Norman Borlaug who said of certain western environmentalists:

“They’ve never experienced the physical sensation of hunger. If they lived just one month amid the misery of the developing world, as I have for 50 years, they’d be crying out for tractors and fertiliser and irrigation canals, and be outraged that fashionable elitists were trying to deny them these things.”⁴⁷

Such a commentary demonstrates how passionate the debate around GMOs can get.

Whatever the future brings the genie is well and truly out of the bottle when it comes to GMOs. Science is not going to rewind. That means that bio security regulation and the economic management of unfolding technologies are the new frontiers to be negotiated with GMOs. Lynas and Swaminathan may be reviled by anti-GMO campaigners but both are committed to the same fundamental idea, how to feed a growing global population, fairly and within global environmental constraints. Swaminathan remains an optimist. At the age of 75 in 1999 he published a book entitled *I Predict: A Century of Hope Towards an Era of Harmony with Nature and Freedom from Hunger*.⁴⁸ Now, that is positive thinking.

Loaves and fish – feeding the 10 billion.

Exactly what the future demand for food will be is a function of population and nutritional demand. That demand will be shaped by issues of socio-economic development and the socio-cultural evolution of food cultures. Obviously people attempt to put a figure on what and when global demand for food will be. In 2011 research published by The US National Academy of Science stated that the demand for crops would increase by 100–110% between 2005 and 2050.⁴⁹

With about 33% of all global land already turned over to food production any increase in cultivation will significantly impact on natural environments.⁵⁰ Consider that most of the uncultivated land worldwide is extremely arid and supports very little bio-capacity and you can see the fundamental problem. It will be areas of relatively high potential net primary productivity that will have to be utilised and there is very little land worldwide of this type which has not already been put into productive service for humanity.

Three key themes will determine how our food future pans out into the 21st century; efficiency, equity and expectation.

⁴⁷ Quoted in The Guardian ‘Norman Bourlaug obituary’ 13. 9.2009. Access at <http://www.theguardian.com/science/2009/sep/13/norman-borlaug-obituary>

⁴⁸ Swaminathan M S (1999) ‘I Predict: A Century of Hope Towards an Era of Harmony with Nature and Freedom from Hunger.’ East West Books Madras.

⁴⁹ Tilman D et al (2011) ‘Global food demand and the sustainable intensification of agriculture.’ Proceeding of the National Academy of Sciences of the United States of America Vol108 No50. Access at <http://www.pnas.org/content/108/50/20260.full>

⁵⁰ FAO STAT United Nations. On-line statistical database on agricultural land globally. Access at <http://faostat.fao.org/site/377/DesktopDefault.aspx?PageID=377#ancor>

One of the most startling pieces of research on food in recent years came from the unlikely source of the Institution of Mechanical Engineers whose 2012 report *Global Food Waste Not Want Not* claimed that between 30 and 50% of all food produced never reaches a human stomach.⁵¹ They also pointed out that such waste extends to the land, energy and material resources used in the production of that unutilised food.

Much of this waste could be viewed as the creative destruction of the market where goods do not find markets at any price because there is no demand and thus resources will be re-employed in more productive activities. Waste as market readjustment, that's OK then. Efficient use of our global natural resource base it is not.

Some of this waste comes from poor infrastructure which is ineffective in linking areas of production – the countryside – with areas of consumption – the cities. Logistics, transport networks, refrigeration and even GMOs that improve storage will all be part of the response. Other aspects of waste come from the abundance of food in societies such as the UK. An average UK family with children in 2010 wasted food worth £680 a year, some 7.2 million tonnes in total, although this is a reduction in waste from 2006.⁵² The waste happens before the food even reaches shops. In the UK 30% of all vegetable crops are never harvested because they are not of 'saleable quality' for modern supermarkets.

We clearly have the capability to create more efficient food production, food distribution and food consumption. Some of the change will have to be attitudinal. We need to be less fussy about the shape of our parsnips.

Then there is the question of equity. Huge disparities are identified by FAO with citizens of the USA – on average – chowing down 3,770 calories a day as opposed to the 1,590 calories consumed by the citizens of The Democratic Republic of the Congo (DRC).⁵³

The principle of moving food around the world to meet demand is established, it is called trade. However the food-poor lack the economic resources to buy additional food to that which they produce. A world that follows the Gandhian maxim "the world has enough for everyone's need, but not enough for everyone's greed" will be a world that doesn't wholly distribute food via the market mechanisms. We already adopt such an approach in certain circumstances through food aid.

⁵¹ Institution of Mechanical Engineers (2012) 'Global Food Waste Not Want Not.' Access at <http://www.imeche.org/knowledge/themes/environment/global-food>

⁵² Food waste statistics courtesy of Love Food Hate Waste website. Access at <http://england.lovefoodhatewaste.com/node/2472>

⁵³ FAO data is available in a very approachable format at Wikipedia. Access at http://en.wikipedia.org/wiki/List_of_countries_by_food_energy_intake#cite_note-3

Those who see this as propping up inefficiency and argue that people should stand on their own feet should consider the ability of the UK to stand on its own feet when it comes to food supply. Even though we exported £128 billion worth of food in 2012 the UK government estimates that 40% of food consumed in the UK is imported.⁵⁴ We are not immune from any of the forces that shape overall global food security. Increasing competition for global food resources such as animal feed cannot be insulated against.

Finally we have to have a look at cultural attitudes to food. In rich economies consumption of food has a strong element of lifestyle choice and often these choices are manipulated by advertising, availability and taste manipulation (chemical interventions to make things taste better, like adding sodium chloride). To some extent we have always strived for better, tastier, more nutritious food, it appears to me a fundamental human pleasure and one that is universally applicable to all cultures of which I have experience.

Globalisation has unleashed an ability to explore taste as an aspirational human trait. Research shows that in all societies as wealth grows both overall calories and protein consumption increase. We eat more and different food.

In China wealth conveys the ability to eat more and better cuts of meat. In India the rate of increase in diabetes associated with changing diet has been significant with now 50 million diabetes sufferers according to recent research.⁵⁵ All around the world diets are changing as expectations change. The future of food may be as much to do with attitudinal change as technology, infrastructure or GMOs.

⁵⁴ Global Food Security website of UK government. Access at <http://www.foodsecurity.ac.uk/issue/uk.html#refs>

⁵⁵ The Indian Express '50 million people in India have diabetes'. 14 November 2012. Access at <http://www.indianexpress.com/news/-50-million-people-in-india-have-diabetes-/1030869/>

Keep it fresh – water for 10 billion.

Twenty miles west of the Taj Mahal in Agra, sitting astride a parched sandstone ridge, is the ancient and deserted city of Fatehpur Sikri. In 1571 the legendary Mughal Emperor Akbar decided this was the ideal place for his new capital city. After spending 15 years overseeing the construction of a city that reflected his magnificence and wealth Akbar abandoned it upon completion. He'd forgotten one thing: a safe, reliable source of water. Over 400 years later the ghostly city remains a testament to the architectural skills of the Mughal era and the vain folly of those who claim dominion over the natural world. Nothing defines the spatial organisation of human endeavour across the planet's surface than the availability of water.

In 2013 humans will, on average, each globally appropriate for their own needs 800 cubic metres of fresh water. Most of this will be in supporting the agriculture that sustains them (about 70%) with 10% for domestic use.⁵⁶ Of that a very small amount is actually consumed as fresh drinking water, the most basic of human needs. In the UK over a third of that domestic fresh water is used to flush toilets and only 8% is for direct human consumption.⁵⁷

One of the fundamental complexities of the issue of water supply is the geographic variations that manifest themselves around the globe. For instance the British Isles is a relatively water rich environment: if you live there you hardly need to be told. Saudi Arabia is an extremely water poor environment. Currently the Saudis consume almost seven times more annually (14.62km³) than their sustainable supply of water (2.4km³). How do they square this dilemma? 50% of Saudi water is now supplied by energy intensive desalinisation plants; another 40% is mined from non-renewable aquifers. Nobody has a precise idea how much fossil groundwater is available.

Saudi Arabia has already surpassed 'peak water', the point at which extraction outstrips sustainable recharge. All this in a country that spends \$2 billion annually on water infrastructure – \$73 for every inhabitant of the Kingdom. As the song goes "There may be trouble ahead..." And the Saudis are not alone. Lester Brown, Head of the Earth Policy Institute, argues that 18 countries containing half the world's population have already reached peak water.⁵⁸ The most significant consequence of this will be declining food yields at a time when food demand continues to grow.

⁵⁶ All key water use statistics can be found at the United Nations water statistics website. Access at <http://www.unwater.org/statistics.html>

⁵⁷ A fantastic resource for water data is The ImpEE project, hosted by Cambridge University which aims to provide a source of data to inform civil engineers about issues of sustainability. Access at <http://www-g.eng.cam.ac.uk/impee/>

⁵⁸ Vidal J (2013) 'Global threat to food supply as water wells dry up, warns top environmental expert.' The Guardian 6 July 2013. Access at <http://www.theguardian.com/global-development/2013/jul/06/food-supply-threat-water-wells-dry-up>

It wouldn't be incumbent on the British to experience a sense of schadenfreude about the Saudi's water challenge. One of equal complexity awaits the population of London. It may surprise you but London receives less rainfall than Sydney (although more rain days) and progressively less as a result of climate change. Furthermore London is a growing city, increasing in density but surviving on a water infrastructure that has its roots in the great Victorian public engineers.

Such is the concern about an impending London water shortage that London Mayor Boris Johnson has started to consider building canals to bring water from wetter parts of the British Isles to a parched London:

“Since Scotland and Wales are on the whole higher up than England, it is surely time to do the obvious: use the principle of gravity to bring surplus rain from the mountains to irrigate and refresh the breadbasket of the country in the South and East.”⁵⁹

To address such challenges London's first desalination plant is now operating in Beckton, east London, drawing water out of the Thames, cleaning it and delivering it to up to a million people in the city.

Of course the obvious way to deal with such fundamental infrastructure is to centrally plan for the overall benefit of the whole society, allowing the principles of sustainable development to be embedded into all solutions. Water - after all - tends to be a 'good' best provided by monopolistic organisations. In London I can't 'shop around' for a water provider.

The United Nations 2012 Water Report puts it thus:

“Managing water well requires appropriate governance arrangements that move considerations of water from the margins of government to the centre of society. On national and local scales, appropriately funded infrastructure and adequately funded robust governance mechanisms are required to protect water resources and ensure sustainable development and the equitable distribution of water-derived benefits.”⁶⁰

However, Thames Water, who manage London's water supply, are owned by Australia investment bank Macquarie. The Abu Dhabi Investment Authority and the China Investment Corporation also own some of the stock.⁶¹ Such interests are only engaged with if it is expected that a solid rate of return can

⁵⁹ Johnson B (2013) 'Ignore this rain, it's the drought we need to think about.' The Daily Telegraph 12.06 2011.

Access at <http://www.telegraph.co.uk/comment/columnists/borisjohnson/8571614/Ignore-this-rain-its-the-drought-that-we-need-to-think-about.html>

⁶⁰ Managing Water under Uncertainty and Risk. The United Nations World Water Development Report 4 Volume 1. UN Water (2012) Page 23

⁶¹ BBC News 20.01.2012 'China wealth fund buys 9% of Thames Water' Access at <http://www.bbc.co.uk/news/business-16643989> and Waterbriefing 13.12.2011 'Macquarie sells 9.9% stake in Thames Water to Abu Dhabi Investment Authority.' Access at <http://www.waterbriefing.org/index.php/home/company-news/item/5043-macquarie-sells-99-stake-in-thames-water-to-abu-dhabi-investment-authority>

be extracted from the investment, it is not engaged in providing a public service. To be fair Thames Water are investing over £1 billion in water infrastructure in the next few years but to a large degree how they operate is framed by regulatory structures put in place by the government. They are, for example, set targets for the percentage of water lost through leakages.

Water – an essential requirement for all life on earth – is now commoditised as something to be traded, profiteered, manipulated and controlled. Whilst wrestling with metaphors Martin Luther King Jr turned to water in his ‘I have a dream speech’. He stated: “until justice rolls down like water and righteousness like a mighty stream.”⁶² He probably didn’t think at that time that such sentiments could be employed to water itself but now, with the global population heading towards ten billion and such grave inequalities being enacted in the supply of water globally, justice for all in accessing this most basic of human commodities is essential for a better world.

And not a drop to drink.

I remain amazed that it takes so much water to make a pint of beer. Figures vary. It depends upon what you count. Some cite a 300:1 ratio;⁶³ others are more circumspect and suggest it is a mere 130:1 ratio.⁶⁴ How come so much water? Well it will include all the inputs; the hops, barley, malt and the water taken to grow them. There are mechanical inputs and the water required in their manufacture and then there is the water that is actually added to the brew. The reality is most of our water consumption is not drinking water but is mainly used in the production of food. Furthermore much of this water we indirectly consume is from countries with more significant water crisis than our own. We export our environmental externalities.

This probably sounds rather esoteric, this thinking about water as a constituent part of everything we do. But it is of such seriousness that the Royal Academy of Engineering – that hotbed of radical greens – commissioned a report in 2010 ‘Global Water Security – an engineering perspective’ that focused significantly on the issues of water embedded in all that we do.

⁶² Martin Luther King jr. Speech given in Washington, USA on August 28th 1963. This speech is more commonly known as the ‘I have a dream speech.’

⁶³ Gleick P et al (2009) ‘The World’s Water 2008-2009’. Island Press

⁶⁴ Black R (2010) ‘UK water use ‘worsening global crisis’ BBC online News 19.04.2010. Access at <http://news.bbc.co.uk/1/hi/8628832.stm>

The report starts off by referring to ‘the perfect storm scenario’ whereby 50% more food and energy and 30% more fresh water will be required by 2050 given global increases in population and consumption, and this in a time of significant climate change. It goes on to explicitly acknowledge that when considering the human relationship with water it is essential that the perspective is globally holistic and governance is democratic, accountable, equitable and rational.

“The UK is reliant on food, energy and goods that require water in their production and transportation by and from countries that are themselves water stressed. This hidden water accounts for over two thirds of the UK's water footprint.”⁶⁵

A kilogram of beef has 15,000 litres of embedded water, a kilogram of rice 3,400 litres.

In countries such as India and China the consumption of water for agricultural production has become a major environmental challenge. The World Bank examined these issues within India in a 2013 report.⁶⁶ It concluded that under a 2°C degree climate warming, agricultural productivity would fall by 12% at a time that its population was increasing

significantly. Furthermore extreme flood events with 1:100 year monsoon events becoming 1:10 year events will be common. This obviously will have deleterious impacts on agricultural productivity. The same story can be told about China.

The ‘new’ water mantra is ‘more crop per drop’: the idea that agricultural productivity can be enhanced whilst at the same time water inputs are reduced. This is a major technical challenge especially in poor rural areas where access to technology, knowhow and capital is slight. It is a biological challenge but attitudinal and economic as well. It is also an engineering challenge, drawing as it does from a scientific systems approach to water management. As for the general public what is needed is a system of labelling that contains information about embedded water in the same way electrical appliances have labelling concerning energy efficiency. Water traffic lights perhaps? With beef, cut flowers from Kenya and beans from Zimbabwe all probably red? Would it change what you buy? Possibly not. But it would be a nudge to remind you that our thirst for water is barely fulfilled with a simple glass of it.

⁶⁵ The Royal Academy of Engineering (2010) ‘Global Water Security-an engineering perspective.’ Page 5.

⁶⁶ World Bank (2013) ‘Turn Down the Heat : Climate Extremes, Regional Impacts and the Case for Resilience.’

Access at <http://www.worldbank.org/en/news/press-release/2013/06/19/warming-climate-india-pose-significant-risk-agriculture-water-resources-health-says-world-bank-report>

Damn dams.

There are about 40,000 large dams currently engineering river basins across the world. Behind these dams lie 400,000 sq km of reservoir – about the land area of Paraguay in South America.⁶⁷ The ubiquity of large dams – and by and large the broad definition of a large dam is a height greater than 15 metres – is very strongly correlated with economic development. The first dams were used to control irrigation in Mesopotamia. This set in train embryonic urbanisation in what became known as the ‘fertile crescent’ from 12,000 years before the present. It will be no surprise that the ancient Egyptians, the early Chinese dynasties, Mughal emperors and the Romans all applied this most basic of technologies to regulate rivers, manage rainfall for irrigation and to supply water for domestic consumption.

In my home city, Sheffield, the fast flowing rivers tumbling out of the Pennines were harnessed by small dams to create the power for early metalworking that led, in time, to a global reputation for metal manufacture and all things that could be bashed into shape from metal. It was the industrial revolution, jumping out of Sheffield, Manchester and Birmingham in the early 19th century, which was the driver for nearly every major river worldwide to be blocked – at present – at some point in their meander by towering concrete or earth walls. They must be a good thing then.

It is undoubtedly true that large dams help feed people, provide them with the water and electricity that their cities crave and are the backbone of much industrial development. Whether it is the vertiginous Hoover Dam bringing the mighty Colorado River to heel in the service of water hungry Las Vegas, or the mighty Three Gorges Dam that provides the equivalent electricity of six or seven large nuclear power stations, dams have become potent symbols of development.⁶⁸

Yet dams have their detractors and the consequences of dam construction can be political, social, economic and environmental. Examples abound. A good river to consider is the 2,700 mile Mekong, rising in the western Himalayas and snaking down to the South China Sea via China, Myanmar, Laos, Thailand, Vietnam and Cambodia. And there is the problem: it is a trans-boundary river and sharing its resources amongst the six countries that all have a geographical stake in it is a task worthy of the allegedly even hand of Solomon.

There are 30 large dams already constructed in the Mekong river basin⁶⁹ with another 7 being constructed including the Ruzhadu Dam in China which will be huge with nearly 6MW of generating power. It will, on completion in 2014, be the 3rd tallest dam in the world. This fevered construction activity does not come without a price beyond that of providing construction companies with a constant source of income.

⁶⁷ International Rivers website. Access at <http://www.internationalrivers.org/questions-and-answers-about-large-dams>

⁶⁸ The largest nuclear power station in the USA has a 3.9MW capacity, some are as low as .4MW

⁶⁹ China 4, Lao 9, Vietnam 10 and Thailand 7.

Cambodia, where the Mekong reaches the sea, will be denuded of water, sediment, fish and control over perhaps its most valuable natural resource. The Cambodians are not happy but they are powerless. And it is power which is often the key dividing line about dams and not simply the electrical power they can generate.

A figure of between 40 and 80 million people is banded about as the amount of people who have been displaced by dams since the 1950s worldwide. Not a very accurate figure. A bit of range. Yet the reason for that is important. These people are predominantly poor and rural and most of them are now poor and urban. They are the collateral damage of dam construction as the land that was their home has been inundated. They have proved difficult to count and few people even bother.

Amongst the mega contracts (\$22.5 billion estimated for the Three Gorges Dam), the political kickbacks and the electricity to fuel the lifestyles of predominantly urban elites are millions of families who are rarely compensated for their loss and who rarely see any of the benefits that flow from these mega projects. They are 'the price worth paying'. They are invisible. They have little power – political or electrical. Such is the uneven nature of the process of development.

Water pistols.

The Nile is one of the great rivers of the world. It was almost my grave. A gentle, touristy, felucca ride across the Nile at Aswan turned into a white knuckle feat of survival as a vicious desert wind blew in and threatened to tip up the unstable boat. Tacking across the river in a style that would have made Sir Ben Ainslie proud – hanging onto a frayed rope my bottom grazing the stormy waters – I desperately tried to keep the boat upright. We eventually made the riverbank. A fair sized crowd had gathered. Nobody clapped.

Rivers can be hazardous not just to foolish tourists but to whole nations because they can be a source of conflict as well as environmental threat through flooding. The Nile is no exception. In the Ethiopian headwaters of the Blue Nile a sizeable dam project (6MW and £8bn) is starting to take shape: the Grand Renaissance Dam. However, a few thousand miles north the Egyptian government have been eyeing it all with great suspicion. Playing the nationalist card whilst his country stumbles through an approximation of democracy, the Egyptian President Mohammed Morsi stated in a televised speech to the nation in June 2013:

"If Egypt is the Nile's gift, then the Nile is a gift to Egypt... the lives of the Egyptians is connected around it... as one great people. If it diminishes by one drop then our blood is the alternative."⁷⁰

⁷⁰ BBC News 10.6.2013 'Egyptian warning over Ethiopian Nile Dam.' Access at <http://www.bbc.co.uk/news/world-africa-22850124>

It may have all been bluster for public consumption because a week further on the talk was more conciliatory with the Ethiopian Foreign Minister saying that the two countries had agreed to “swim together rather than sink together.”⁷¹

However in the arid lands of the Middle East water is clearly a weapon. Such an understanding stretches right back into the Old Testament with Exodus verses 15-17 concerning the search for water as Moses leads the Jews to the Promised Land:

“Why, now, have you brought us up from Egypt, to kill us and our children and our livestock with thirst?” is the plea from the parched followers.⁷²

Such priorities still frame life in Israel and the Palestinian Territories and it is clear whose hand is on the tap. Compare and contrast. In the Palestinian West Bank Territories only 2.6% of the population are not connected to a running water supply. However how much is actually coming through the taps is a moot point. The per capita use is 77 litres and that is for agriculture, industrial and domestic use. Across the wall and using the same aquifers Israeli per capita water use is 242 litres.⁷³ The drilling of new wells into the aquifer, and access to the water of the River Jordan, is tightly controlled by the Israeli government. They in effect hold the power of life and death over the population of the West Bank.

In Gaza the situation is worse. Hemmed in on all sides with nearly 10,000 people per square kilometre, the water and sewage management teeters on the brink of collapse.⁷⁴ Today 90% of the aquifer is polluted by sewage and with up to a third of household income now being spent on bottled drinking water and an expanding population of 1.6 million Gaza is predicted by a 2013 United Nations report to be effectively unliveable by 2016.⁷⁵

It is little surprise that the NATO bombing of Serbia in 1999 included targeting water supply facilities in the capital Belgrade. If you want to bring an urban population to its knees swiftly nothing works better than depriving it of water and sanitation. Such sentiments are not lost on the Egyptians. Visiting the 2.1GW Aswan High Dam that regulates the upper Nile in Egypt the array of military warnings, bristling weaponry and poised ground-to-air missiles clearly marks out the installation as of significant strategic importance. People go to war over water on a daily basis in small battles the world over. Sometimes they think big and think about water wars.

⁷¹ BBC News 18.6.2013 'Egypt and Ethiopia vow to defuse Blue Nile dam row.' Access at <http://www.bbc.co.uk/news/world-africa-22951276>

⁷² Exodus 17-1:3

⁷³ BTselem 01.01.2013 'The Gap in Water Consumption between the Palestinians and Israelis' Access at http://www.btselem.org/water/consumption_gap

⁷⁴ BBC News 27.10.09 'Gaza thirsts as sewage crisis mounts.' <http://news.bbc.co.uk/1/hi/8327146.stm>

⁷⁵ Nidal al-Mughrabi Reuters 26.06.13 'As Gaza heads for a water crisis desalination seen as the answer'. Access at <http://www.reuters.com/article/2013/06/26/us-israel-palestinians-water-idUSBRE95P0RK20130626>

Yorkshire sile.

The luxury I enjoy – a constant and relatively cheap source of water – is heightened by its quality. Straight off the Peak District moors, water in Sheffield is tasty. When I first moved to Sheffield in the early 1980s, on days after it had rained heavily a settled, run bath left gritty sediment on the bottom of the bath. This was flecks of moorland peat. Since the 1990s a new pumping plant has come on stream and even this minor inconvenience has been lost. This tap water is superior to anything a poor Londoner may have to quaff which hasn't come out of a plastic bottle.

There is a minor distaste I feel towards this water and that is the organisation that brings it to me: Yorkshire Water. It is not that they aren't a competent organisation. Ofwat, the water regulator, isn't breathing down their necks at their misdeeds, although the particularly harsh winter of 2010 created a leakage problem that saw them waste 325 million litres a day (130 Olympic swimming pools worth).⁷⁶ No, it is the fact that they are not an organisation whose primary mission is the public good but a private company whose aim is to maximise profits and share holder value.

So who are Yorkshire Water? Well they play on their local roots with their website littered with stereotypical dialect.

“Ay up Mary, did you know that between 2010 and 2015, Yorkshire Water is investing £3.5 billion into the region? Ow much? By 'eck Edna, I don't think even our Brian knows how many shillings that is? and he's an accountant!”⁷⁷

But let's not be fooled. Yorkshire Water are predominantly owned by foreign business interests and they have constructed a financial edifice that makes this far from transparent and enables them to avoid paying substantial amounts of corporation tax. As they would say, they are tax efficient.

Trying to navigate your way through the ownership structure of Yorkshire Water is far from straightforward. In February 2008 the parent company Kelda was de-listed from the London Stock Exchange. It became a wholly private entity owned effectively by 3 partners who in themselves were owned by other interests. It goes like this, or did in 2008: Yorkshire Water are owned by Kelda Group plc, who are owned by Saltaire Water, who are owned by Skeldergate Eurobond Co Ltd, who are owned by Skeldergate Topco Limited (Jersey), who are ultimately owned in a three-way partnership between Citi Infrastructure Investors, GIC Infra Holding PTE and Infracapital Partners LP.⁷⁸

⁷⁶ BBC News 26.10.2011 'Yorkshire Water failing on leakage targets, says Ofwat.' Access at <http://www.bbc.co.uk/news/uk-england-15457718>

⁷⁷ Yorkshire Water website. Access at <http://www.yorkshirewater.com/policy-source/investment-in-yorkshire.aspx>

⁷⁸ Ofwat. 'The completed acquisition of Kelda Group PLC by Saltaire Water Limited.' Consultation paper June 2008

We can go further. GIC are ultimately the Singaporean Government. Citi Infrastructure are a part of Citigroup one of America's largest banks. From 2008 the Singaporean government became a major investor in Citigroup when it ploughed in £7 billion of cash to prop up the ailing bank in exchange for 4% of ownership.⁷⁹ The last partner is basically an investment vehicle for Prudential the British based but global investment company which has moved on considerably since the 'man from the Pru' came knocking on your grandparents door for their pension contributions.

Such a complex web only adds weight to the argument that so much of the modern global economy is transactional, where debt is used to offset potential tax on profits. Whatever it is, for its owners this is a very tax efficient construction. From 2010 to 2013 Yorkshire Water had turned over £2.6 billion which had generated a profit of £990 million. They received a net tax credit of £42 million. That is right we paid them rather than the other way around. This information came from Conservative MP Charlie Elphicke.⁸⁰ He is a tax lawyer and he is outraged.

This parochial little story isn't just about Yorkshire it is about the very nature of the global economy and its grip on the most basic of commodities of life. I feel a little quaint and old fashioned suggesting that maybe water supply and sanitation should be a public good. Opinion polls suggest I am not out of step with the public mood with more than 70% wanting the renationalisation of water companies.⁸¹

It may rain heavily in Yorkshire (sileing as the copywriters for Yorkshire Water might say) compared with the arid regions of the Middle East but issues of control and power sit behind even the most bucolic of Pennine reservoirs. This unfolding century will see a range of water management challenges that may test the patience of water consumers, or 'the people' as I'd prefer to call them. A greater risk of flooding events and drought events – even though overall water inputs will probably not vary considerably – seems almost certain. Furthermore, sitting pretty on our lush rain sodden land is fine for Yorkshire folk but you should see the challenges of London and the south-east. Maybe we should share our water with them and they could share some of the wealth generated by companies like Kelda Group. That is if they ever pay tax.

⁷⁹ Bloomberg 15.01.2008. 'Citigroup Merrill Recieve \$21Billion from Investors.' Access at <http://www.bloomberg.com/apps/news?pid=newsarchive&sid=anjGWhqi0PSE&refer=home>

⁸⁰ Yorkshire Post 28.09.2013. 'Yorkshire Water to explain its use of tax haven.'

⁸¹ Coates, Jon. (2012)'71% say renationalise water industry.' The Daily Express 06.05.2012. Access at <http://www.express.co.uk/news/uk/318424/71-per-cent-say-renationalise-water-industry>

Thirsty for change.

Michael Eavis is somebody who knows a thing or two about water. Every year he has to supply 11 million litres of water to the revellers who converge upon his farm for the Glastonbury Festival. He plans ahead and has built two underground storage reservoirs to cope, improved the local mains feed and constantly monitors water levels, usage patterns and quality. Since 1994 Glastonbury Festival has raised money for the British Charity WaterAid. It adorns all their logos, it informs what and how they manage water on site, it raises a significant amount of money for the charity.

Glastonbury is one of numerous supporters of WaterAid. Even Yorkshire Water is a supporter, although a trawl of the accounts of both organisations hasn't come up with a figure for the size of the donation from either organisation, Glastonbury or Yorkshire Water.

Yet that Water Aid can attract such a disparate range of support, raising £50 million a year to spend on projects worldwide, is testament to their qualities as a charity and the urgent imperative of their work. Whether in India, Bangladesh or Zambia WaterAid concerns itself with on-the-ground practical support to extend access to safe water and improved sanitation. That such work is essential is borne out by the fact

that some 768 million people, over one in ten of the world's population, still lack access to safe clean water.⁸³ The sanitation situation is even worse with 2000 children a day dying from diarrhoea.⁸⁴

Apart from quenching our thirst water underpins all the food we eat, it is embodied in its production and with the World Bank commenting "high and volatile food prices have become the new normal"⁸⁵ the challenges that present themselves to the world as this century unfolds are all encompassing and complex. We are connected at a global level between subsistence farmers in sub-Saharan Africa and the 'Sheldon's' of bioscience, quietly reformulating the very stuff of life in prestigious university laboratories. When the EU fends off low cost producers in Africa with high cost subsidy and tariff boundaries we shape landscapes in both Africa and Britain. When the transactional global corporations in which unequal wealth is stored team up with grass-roots charities striving to enhance the quality of life of the most marginalised the connections become political as well as environmental. Food and water have always connected diasporas and the disparate.

Of course at a core level the centrality of food and water to our lives is shaped by our economic position, our ability to access resources. In Tanzania food costs are 62% of household income, in the UK this falls to 9%.⁸⁶ Yet access to food has

⁸³ WHO/UNICEF Joint Monitoring Programme (JMP) Report 2013 update

⁸⁴ Child Health Epidemiology Reference Group, 2012 and Unicef Child Mortality Report, 2012

⁸⁵ World Bank 2013. 'Food Crisis'. Access at <http://www.worldbank.org/foodcrisis/bankinitiatives.htm>

⁸⁶ <http://www.economist.com/blogs/graphicdetail/2013/03/daily-chart-5>

to a large degree been a significant success story. Globally, development over the past 200 years has been a story of all nations starting off as poor and unhealthy and today the majority of nations being – relatively speaking – wealthy and healthy. This lesson is best explained by Hans Rosling in his snappy ‘200 Countries, 200 Years and 4 Minutes.’ video.⁸⁷

But the question to pose to Rosling, for all his pedagogic genius, is why he so confident of a new converging world where “everybody can make it to the healthy, wealthy corner”. Sure the evidence to now is pretty convincing but what about the convergence of existential challenges into a ‘perfect storm’. There is going to have to be a bit of ideological grit in there as well to even consider the possibility of his happy future.

But here is some food for thought. If we believe that we can carve out a better future for humanity and a sustainable future for our planet, as Rosling and other practical possibilists like Danny Dorling and M.S. Swaminathan suggest, the first step is to start thinking that it is possible. OK so it errs towards a belief in something, a belief in humanity as a potential force for good. I’m a believer.

⁸⁷ Hans Rosling ‘200 Countries, 200 Year, 4 Minutes’. Access at <http://www.gapminder.org/videos/200-years-that-changed-the-world-bbc/>

Everything is Connected to Everything Else Project.

Words – Carl Lee

Graphics/Animation – Abby Hambleton (HumanStudio)

Art Direction – Nick Bax (HumanStudio)

Music – Matt Howden – The Mighty Sieben

Proof-reading – Thom Sullivan

Critic and advice – Danny Dorling

Inspiration – Sheffield College A level students 1990-2014

www.everythingisconnected.io