

# Lies, misconceptions and global agriculture

Global food strategies, government policies, academic research programmes and popular literature are informed by ideas about food and agriculture that in large part are ill-founded and untrue: that the world needs to produce more and more food to keep pace with rising population and particularly with the increasing 'demand' for meat; that we need crops and livestock that are ever more productive; that the extra food we are supposed to need can be provided only by high-tech means – and particularly by the use of genetically modified organisms; that it is more 'efficient' and therefore necessary to reduce the farm labour force; that organic farming must always be niche. Uncritical acceptance of these ideas is preventing development of strategies that could solve the world's food problems and a great deal more besides.

More or less everything that we are told about food and farming by the oligarchs who dominate our lives – the government, the corporates, big finance and large, but mercifully not all, sections of academe – is untrue, or at least is seriously misleading. This is why the world is in such a mess – and why we must take matters into our own hands. The misconceptions that underpin present-day agricultural strategy reflect the over-confident, ultra-'rational', reductionist, materialist, positivist and imperialist mindset of the post-Enlightenment Western world. The general, almost unquestioned, assumption is that humanity's task in life is to make ourselves more and more comfortable; that this can be achieved only, or primarily, by producing more and more *stuff*, including food; that it is possible to go on producing more and more, even though the Earth is finite, because technology will always find a way; that, indeed, the pursuit of science will one day make us both omniscient and omnipotent, so we'll soon understand everything and be able to control everything for our own purposes; that this – essentially Western – way of thinking is superior to other ways of thinking (because those who think in the Western

way become technically powerful and so are able to dominate the rest); and hence that the present world, led intellectually by the West, is on the right lines (despite appearances) and we can safely put our trust in our present leaders.

All these beliefs must be re-examined. Here, though, is a re-examination of six particular untruths that have come to dominate global agriculture and are leading the world hopelessly astray.

## Untruth 1: We must produce more and more food

In 2011, the UK government told us that humanity needs to produce 50% more food by 2050 just to keep pace with rising population and rising 'demand' – especially for meat (Government Office for Science, 2011). The United Nations' Food and Agriculture Organization has long argued that we need to increase food production by 60–70% by that date (e.g. Alexandratos and Bruinsma, 2012); and a much-cited study published in the prestigious *Proceedings of the National Academy of Sciences of the United States of America* has argued that food production needs to *double* by then (Tilman *et al.*, 2011). In short, the emphasis must continue to be on production, production and ever more production.

## Colin Tudge

### About the author

Colin is a biologist by education and a writer by trade. He co-founded the Campaign for Real Farming and the Oxford Real Farming Conference and is currently setting up the College for Real Farming and Food Culture. His latest books include *Why Genes are Not Selfish and People are Nice* (Floris Books, 2013) and *Six Steps Back to the Land* (Green Books, 2016).

### Citation

Tudge C (2018) Lies, misconceptions and global agriculture. *The Ecological Citizen* 2: 77–85.

### Keywords

Agriculture; sustainability

---

“The emphasis must switch from production to sustainability and resilience, and to care of the biosphere, human and animal welfare, social justice and general kindness.”

---

### In truth...

According to Professor Hans Herren, President of the Millennium Institute (Washington, DC, USA), the world already produced enough food in 2011 to feed 14 billion people (Roseboro, 2011). This is nearly twice the present world population and, based on the United Nations' estimate of a world population of around 11.2 billion in 2100 (United Nations, 2017b), it is 25% more than we are likely to need at any point this century (see Kuhleman [2018] for more on food and population). The continued emphasis on production has nothing to do with real need, and everything to do with commerce.

Anyone who wants to can easily check current figures for themselves. The World Bank tells us that the world currently produces nearly 3 billion (metric) tonnes of cereal per year. Since one tonne contains enough energy *and protein* to feed more than 1,000 people for a day, our current annual global production of cereal contains enough macronutrients to feed more than 8 billion people. But cereals account for only half our food – the other half comes from pulses, nuts, tubers, fruit and vegetables, meat, dairy and fish. So the current total is enough for 16 billion-plus.<sup>1</sup>

At present, says the Food and Agriculture Organization of the United Nations (2017), “There is more than enough food produced in the world to feed everyone, yet 815 million people go hungry.” That has everything to do with economic and political inequality and general disruption (notably war) and nothing to do with the total amount of food produced (as Amartya Sen has long argued; see Sen [1982]). The emphasis must switch from production to sustainability and resilience, and to care of the biosphere, human and animal welfare, social justice and general kindness. Industrial agriculture is anything but sustainable – it is a major cause of global warming (contributing nearly one-third of greenhouse gas emissions [Gilbert, 2012]) and the prime cause of the mass extinction that now threatens the majority of the world's species. It is certainly not kind, or just, and has little to do with human

well-being. For while a billion go hungry a billion more suffer ‘diseases of excess’. Among other things, the world population of people with diet-and lifestyle-related diabetes now exceeds the total population of the US by some margin (World Health Organization, 2017).

### Untruth 2: As people grow richer, demand for meat increases

This is obvious from the fact that as societies are ‘lifted out of poverty’ meat consumption rises prodigiously. For example, the US became hooked on steaks and burgers during the post-war economic boom of the 1950s and 60s; and the Chinese – for centuries sustained on rice with very little use of meat – are now ‘demanding’ all the pork, beef and chicken that they can produce themselves and the rest of world can supply them with. Beijing and other big Chinese cities bristle with burger joints. In Britain, successive secretaries of state have told farmers that they should strive to produce more and more pork and beef for export to China.

### In truth...

Nutritionists have been telling us for decades that we, human beings, do not *need* a great deal of meat, and of course, many people live long and agreeable lives on a vegetarian or even a vegan diet. Most people, it seems, do like meat, but there is very little evidence for active ‘demand’. No-one to my knowledge has ever taken to the streets with placards demanding more meat, in the way that they have often demanded fairer wages or more jobs or rights for various minorities. The evidence, when looked at objectively, is that people eat what is available and what – for whatever reason – is deemed high status and fashionable.<sup>2</sup> We need not assume that the observed correlation between rising wealth and meat consumption is any more than a tautology: that meat in general is expensive and as people grow richer they can eat more expensive things – not just meat but also chocolate and cream cakes and a better class of alcohol. California and Germany are amongst the

world's wealthiest regions, yet are also the world's epicentres of vegetarianism. More generally, *all* the world's greatest cuisines – from Italy to China via the Middle East and India – make only sparing use of meat, as garnish or stock and for occasional feasts. Thus a low-meat diet does not mean austerity. We just need to re-learn how to cook.

The real reason for promoting meat so vigorously is not to meet the needs or satisfy the deepest desires of the human race. It is to dispose of arable surpluses. On industrial farms, which Western governments now put their weight and our money behind, more and more livestock is raised largely or exclusively on cereal and soya (not least on what is referred to in the US as 'CAFOs' – 'concentrated animal feeding operations'). The greatest problem for world agriculture is not to produce enough food (see my discussion of Untruth 1 above) but to avoid producing too much, for surpluses tend to be sold unprofitably or even at a loss. We already produce far more grain and other staples than the world really 'needs'; but animals can consume all the cereal (and soya) that arable farmers can produce – provided producers and processors can hype up the demand for meat. This they do; and a variety of academics and policymakers are content to put their critical faculties on hold and help them to do this.

If even the livestock market is glutted (perhaps because farmers do not have enough animals to consume all the surplus cereal and soya that is going), then these days that surplus can be turned into alcohol and called 'biofuel', of which modern governments like those of Britain and the US make a virtue, and support with public money. In other words, industrial farmers solve the problem of surplus cereal by *burning* it – profitably. This is economically ingenious, but it does humanity little or no good and does the biosphere a great deal of unnecessary harm.

### Untruth 3: We need ever more productive crops and livestock

We are further assured that the huge increase in food that we allegedly need

can be provided only by raising, yet further, the already prodigious output of our cereals and livestock – and this is to be achieved by ever more intensive breeding and nutrition. Thus we need wheat that yields at least 10 tonnes per hectare on average, about three times the yield of 100 years ago (the British average is already nearly nine tonnes per hectare [Department for Environment, Food and Rural Affairs, 2015: 1]). We need cattle that give at least 10,000 litres (2000 gallons) per lactation, which basically means per year – which many do already: about six times as much as a wild cow would produce for her calf, and three times more than would have satisfied most farmers of the early 20th century. Broiler chickens are already expected to reach supermarket weight at six weeks and we need to make them even faster, bigger or both – and cheaper. Sows in Australia produce an average of 22 live piglets a year in two litters, while those in the US manage 28 – about four times the typical 'output' of wild boars (PigCHAMP, 2017).

#### In truth...

Given that we already produce far more food than we really need, and do not in fact require a lot of animal protein for a healthy diet, it follows that the rapid-growth chicken and the prodigiously fecund sow are simply unnecessary. So too is the 2000-gallon-plus cow, which commonly suffers mightily from mastitis and lameness and is usually slaughtered after two or three lactations (traditional dairy cows commonly managed 10 or more). So too are 10-tonnes-per-hectare cereals, which in large part are grown to feed these beasts. Such crop yields, produced year after year with the aid of artificial fertilizers, rapidly exhaust the soil and destroy its structure. It is now reckoned that many fields in parts of the UK, for example, will not be farmable, at least for cereals, for more than another 30 years or so (Department for Environment, Food and Rural Affairs, 2018). Indeed, according to the United Nations Convention to Combat Desertification, about a third of

---

“Industrial farmers solve the problem of surplus cereal by *burning* it – profitably. This is economically ingenious, but it does humanity little or no good and does the biosphere a great deal of unnecessary harm.”

---

all the world's agricultural soils are now seriously degraded – largely, and to some extent entirely, because of such intensive, industrial farming (United Nations, 2017a).

#### Untruth 4: Only high-tech can save us now

We are also given to understand that to go on feeding ourselves we need the highest of high technology. Meat substitutes made from soya or fungi are already commonplace but we could, we are told, bypass the need to raise whole organisms and simply culture animal cells *en masse* in the laboratory. The food industry is working on it (*e.g.* Fassler, 2018).

Above all, we are told, we need genetically modified organisms (GMOs), tailor-made by genetic engineering. GM soya, maize and rape (canola) is already sweeping the world. GM crops are not yet grown commercially in Britain and mainland Europe but are freely imported from the US and elsewhere – mainly for animal feed. Although there are plenty of protestors, GM maize, soya, canola and cotton are now broadly accepted in the US, for example, as the normal way of things.

We are told, of course, that GM crops can be and are bred specifically to be pest- and disease-resistant and so can outyield conventional types without the protection of pesticides. But most popular are the GM crops that are herbicide resistant – enabling farmers to spray their fields not exactly with abandon but without too much restraint, to kill the weeds without killing the crops. The GM seeds and the herbicide are sold as a package.

#### In truth...

It is very hard to find any clear examples of GM crops that have been of unequivocal benefit to humankind. Almost always they serve mainly or entirely to make rich people richer (the biotech companies and big industrial farmers) but they solve no problems that really need solving, and (despite denials) are causing enormous collateral damage. But then, modern industrialized agriculture is entirely profit-driven and it is the rich who

make the rules, so GMOs are becoming *de rigueur*.

In addition, the global biotech lobby is tremendously strong, its arguments are seductive and many politicians are taken in by them. Especially amenable are those with no scientific background who want to appear *avant garde*, up to date, modern and 'progressive'. To take two UK examples, Tony Blair, who read law at Oxford, was a positive GMO zealot, and so too is Lord Dick Taverne, who studied ancient history at Oxford, became a QC and founded the pro-GM charity Sense about Science in 2002. They, in common – alas! – with most scientists, seem not to realize that science has significant limitations: it cannot lead us to omniscience, and ideas that are exciting in the laboratory do not necessarily lead to good outcomes when applied in the real world.

Appropriate technology that truly makes life easier is certainly worthwhile, and some appropriate technology is indeed high-tech – like the mobile phone or solar panels. But much of today's agricultural high-tech – including the much vaunted GMOs as outlined above – is not appropriate at all: not needed, and often very damaging. There is a huge and growing literature on this not only in polemical articles but in scientific journals (not all scientists are on the side of big business). However, this literature is simply ignored in the most influential circles – or else answered with statistical quibbling, mostly of the kind that could be applied to almost any scientific study, if anyone cared to do so. The quibbling does not answer the objections, but it can hold things up and wear the opposition down – which is what it is intended for.

The biggest point perhaps is that large, high-tech, monocultural farms are *not* the most productive – certainly not when measured over longer time periods. A growing literature shows that small mixed farms, well managed, can be at least as productive in any one year as the big monocultures, and generally are more productive when measured over decades (for a summary of some of this literature, see Winter *et al.* [2016] and Laughton [2017]).

“Large, high-tech, monocultural farms are *not* the most productive – certainly not when measured over longer time periods.”

This is because the mixture of crops and animals on such farms leads to resilience, so the mixed farms are better able to resist setbacks, such as droughts or late frosts. Mixed crops and livestock are also far more resistant to disease, and simply do not require large inputs of pesticides and antibiotics.

### Untruth 5: Fewer workers means greater efficiency – and efficiency is all

Then, we are told, we need to reduce the farm labour force worldwide to make it more 'efficient'. A key measure of efficiency, after all, is output per worker. If the workforce is reduced and the remaining workers produce as much or more than before, then that is, surely, an increase in efficiency. And efficiency is good, is it not? The antithesis, after all, is *inefficiency*, which means waste – which is obviously bad, is it not? Who can doubt that?

Therefore, we are told, the whole world should strive to industrialize its farming. As far as possible we must replace farm labour (stroppy; inefficient; gets sick) with machines, industrial chemistry (including fertilizers, antibiotics, fungicides, herbicides, insecticides, acaricides and nematocides), and of course biotech. Machines do not deal easily with mixtures of crops and livestock and so, for reasons of efficiency, farming must as far as possible be monocultural – just one crop, or type of beast, at a time. All should be increased to achieve economies of scale: combine harvesters as big as small houses; trucks the size of small warships; small fields merged into bigger and bigger fields and small farms merged into vast estates. So it is that there are farms in the UK exceeding 1000 hectare (roughly 2500 acres) with just one full-time employee (though many rely on seasonal groups of immigrants, bussed in to do the fiddly bits). There are farms in the Ukraine bigger than Kent; there is a cattle farm in Australia larger than the state of Israel. This too is modernity.

Monocultural farms that produce vast quantities of just one thing at a time cannot of course feed local populations

who do not live by chickens or maize or rapeseed alone. Instead they must treat all their crops and animals as *commodities* to be produced on the largest scale and sold into the global market where they are processed, packaged and distributed by evermore labyrinthine routes (with plenty of scope for chicanery, profiteering and general malpractice) to the far corners of the Earth.

So it is that Britain's farm labour force has dropped from around 700,000 in 1984 (when industrialization was already well advanced) to 466,000 in February 2018 – that is, a mere 1.5% of the total UK workforce is now employed in agriculture. In the US, about 8% of the labour force was engaged in agriculture in 1960, and, as in the UK, this has now declined to about 1.5%. To take another telling statistic, in the ten years between 2006 and 2016 the number of dairy farmers in Britain fell by 50% from 21,000 to 10,500 – and still the decline continues. These trends are worldwide: agricultural workers have declined from 42% of the global labour force in 1991, to 28% in 2017. It is a fair bet that many of the 1 billion people who now live in urban slums in the Global South are dispossessed farmers or their dependants.<sup>3</sup>

All this is necessary, we are told. It keeps costs down and people above all 'demand' cheap food. Already in Britain, 1 million people a year must resort to food banks, and if we farmed any differently, it might seem, the figure would be higher.

#### In truth...

'Efficiency' is a horribly abused concept. If efficiency is defined in monetary terms, then it depends entirely on an economic context which, in reality, is highly contrived (no matter how often we are told that prices are determined by the dispassionate forces of the 'free market'). For example, industrialized agriculture is highly dependent on oil and is cheaper than traditional forms of agriculture only because oil is still available, for the time being, and its price is regulated to make sure it is still affordable (just). Perhaps even more to the point: industrial farming

---

“Industrialized agriculture is highly dependent on oil and is cheaper than traditional forms of agriculture only because oil is still available, for the time being, and its price is regulated to make sure it is still affordable (just).”

---

---

“Organic farming, so despised by the powers that be, dismissed as an elitist myth, ticks all the boxes that really matter.”

---

is cheap only because the collateral damage it causes is largely uncoded – including the cost of mass unemployment, in money (including international aid) and human misery, as the countryside worldwide is depopulated. These costs are not attributed to industrial farming (Fitzpatrick and Young, 2017). Nor is the cost in non-cash terms (or even in cash terms) of mass extinction. All this collateral damage is, in economic jargon, an ‘externality’. Nothing to do with me, gov.

Nor, when you analyse it, is the industrially produced food sold in supermarkets anything like as cheap as it may seem to be; and nor can the full cost be laid at the feet of the farmer and agricultural labour. In truth, with the industrialized food chain the farmers typically get less than 20% of the retail price and their poor benighted employees, who are regularly thrown out in the name of ‘efficiency’, probably account for only 10% of the retail price (at most). The 80% that remains goes on big machines and fancy forecourts and packaging and razzmatazz and layers and layers of managers and shareholders and bankers who lend the money to make it all possible.<sup>4</sup> This all contributes to GDP, but it does not contribute to human wellbeing and does enormous harm to the biosphere.

### **Untruth 6: Organic farming is a middle-class indulgence – strictly niche; it cannot possibly feed the world**

As for organic farming – don’t be ridiculous! If all the world farmed organically, food would cost a fortune and half the world would starve. Either that or we would all have to be vegans, and austere vegans at that, living on fibrous bread and lentil soup. It is true that sales of organic produce are going up globally, but they still amount to only a tiny proportion of the total spend on food and drink. For example, in the UK, organic makes up only about 1.5% of the total spend on food and drink, whilst in the USA, it amounts to only about 5% (Organic Trade Association, 2018; Soil Association, 2018). Organic food is elitist; strictly for the well-heeled, elite

middle class. To recommend it for the world at large is simply to be irresponsible. Only high-tech, industrialized farming, driven by the competition of the global ‘free market’, can deliver on the largest possible scale.

### **In truth...**

Organic farming, so despised by the powers that be, dismissed as an elitist myth, ticks all the boxes that really matter. Well-managed organic farms can be at least as productive as ‘conventional’ farms that rely on artificial fertilizers, pesticides and the rest (*e.g.* Badgley and Perfecto, 2007; Nemes, 2009; Seufert *et al.*, 2012). The produce is of course free of pesticide residues and generally is high in essential vitamins and minerals. Organic farms employ more people – which in this populous world should be seen as a good thing; and with *appropriate* technology, the jobs they provide can be highly agreeable and sociable – the basis of truly fulfilling careers.

### **What is to be done?**

These six untruths are a fair summary of official government policy in many countries (*e.g.* the UK and the US) and are what you will hear from most of the important-looking people who appear on public platforms and on TV to tell us what is what. Whether the policymakers and those who inform public opinion are themselves ill-informed, or are deliberately concealing what they know to be the truth, I do not know. I suspect it is a mixture of both. Either way it is deeply reprehensible.

All in all it has long been obvious to me and a great many other people that the oligarchs who dominate our lives have lost the plot and, quite simply, are not on our side. Successive US and British governments, in particular, over the past 35 years have seen it as their role in life not directly to meet the needs of the people but to support the corporates (and banks) that are perceived to provide the wealth that is supposedly vital for our well-being – the *sine qua non*. If and when there is any money left over we can spend some of it on the

biosphere, but we cannot afford to do that until, well, we are richer than we are now (or indeed are ever likely to be). Agriculture is run on this assumption – perceived somewhat chillingly as ‘a business like any other’. Housing, education, transport and healthcare are increasingly all now subject to the same neoliberal mentality. Enterprises that do not yield maximum measurable wealth in the shortest time – and concentrate that wealth so that it benefits those who do the measuring – are not considered ‘realistic’. Apparently it is more important to maximize wealth, expressed as GDP, than it is to promote human well-being and to keep the biosphere in good health. However, agriculture is in fact of tremendous importance and we simply cannot afford to leave it to the present oligarchy, driven as it is by this neoliberal mindset.

### The UK as an example

In the remainder of this article, I focus on the example of the UK, but I hope that it will be useful for readers in other countries facing similar issues. In Britain, the implication of my argument is that we cannot afford to leave agriculture to the Department for the Environment, Food and Rural Affairs. Indeed, the word ‘agriculture’ has been air-brushed out of the department’s title – I suspect in anticipation of a time when British agriculture itself will be air-brushed out, like coal-mining, because Brazil and Africa have more sunshine and cheaper labour and at least for the time being can grow what we need more cheaply than we can grow it ourselves. Neither can we afford to leave agricultural science to the Biotechnology and Biological Sciences Research Council – the title of which again makes no reference to agriculture, which is now officially conceived, apparently, as a branch of biotech.

We, people at large, need to take matters into our own hands. I have summarized some of the things we need to do and can do (and, here and there, are already being done!) in *Six Steps Back to the Land* (Tudge, 2016). In particular, in Britain I suggest we need a new, quasi-independent agency, or

series of agencies, to run food and farming – similar to the community-organized agencies that plan and run the dikes of Holland, without which the country would be submerged. The Dutch long ago acknowledged that the dikes were too important to be run by governments, subject to political ambition and whim. This agency for food and farming that we need must be run, not as such agencies often have been, by the great and the good and their spouses, but by people who really know what needs doing, which mainly means farmers, cooks, and conservationists, with input from scientists, sociologists and people at large who give a damn.

Two initiatives that I am heavily involved in – the Campaign for Real Farming ([www.campaignforreal Farming.org](http://www.campaignforreal Farming.org)) and the College for Real Farming and Food Culture ([www.collegeforreal Farming.org](http://www.collegeforreal Farming.org)) – are aimed at contributing not only to better food and farming but to grass-roots control dedicated to this end. *Six Steps Back to the Land* discusses ways in which people who may have never thought much about farming can get involved, and how communities can start to run things for themselves. As an important new book (Pimbert, 2018) argues, people *everywhere* must get more involved – not simply in on-the-ground farming but in shaping policy. The book is truly radical, and right now radical thinking is vital.

However, farmers cannot farm in the way the world really needs unless people at large buy their produce; sound farming depends on a sound food culture. People at large need to give a damn, and although we cannot all be farmers and do not all want to be, we can all take a serious interest in food. This means, as far as possible, buying only from growers and farmers who are doing the job in the right way. Vitally, too, we must re-learn how to cook. Governments that encouraged this really would be doing something useful.

It is not quite too late to bring the world out of its tailspin but only we can do it. Governments and big industry and the world’s most powerful financiers are looking the other way. ■

---

“Farmers cannot farm in the way the world really needs unless people at large buy their produce; sound farming depends on a sound food culture.”

---

“It is not quite too late to bring the world out of its tailspin but only we can do it. Governments and big industry and the world’s most powerful financiers are looking the other way.”

## Notes

- 1 These estimates are very conservative. For information on global cereals production, see World Bank open data at <https://is.gd/qZXUwy>. A tonne of cereal contains (as a conservative estimate) at least 3 million kcal (Nelleman *et al.*, 2009). The recommended energy intake for an adult male is 2500 kcal per day; for an adult woman it is 2000 kcal per day (World Health Organization, 2004). For further discussion see Cassidy *et al.* (2013).
- 2 In support of this, in a meta-analysis Kearney (2010) observes that whilst it is universally true that as poor nations become wealthier, the total energy intake of the populace tends to increase (*i.e.* people tend to consume more calories in total), it is *not* universally true that a substitution of meat for non-meat dietary sources occurs. As he notes, such substitution is “country-specific and is influenced by culture, beliefs and religious traditions.”
- 3 UK figures are from the Office of National Statistics (2018). For the US, see Bureau of Labor Statistics data at <https://is.gd/HdCmJf>. For global statistics, see World Bank open data at <https://is.gd/Hot247>.
- 4 The US Department of Agriculture estimates that, in 2017, approximately 16 cents in every dollar spent on food and drink in the US went to farmers, with off-farm costs (including marketing, processing, wholesaling, distribution and retailing) making up the remaining 84 cents (National Farmers Union, 2017).

## References

- Alexandratos N and Bruinsma J (2012) *World Agriculture Towards 2030/2050: The 2012 revision* (ESA Working Paper 12 – 03). Food and Agriculture Organization of the United Nations, Rome, Italy. Available at <https://is.gd/EWc2Ur> (accessed March 2018).
- Badgley C and Perfecto I (2007) Can organic agriculture feed the world? *Renewable Agriculture and Food Systems* **22**: 80–5.
- Cassidy E, West P, Gerber J and Foley J (2013) Redefining agricultural yields: from tonnes to people nourished per hectare. *Environmental Research Letters* **8**: 034015.
- Department for Environment, Food and Rural Affairs (2015) *Farming Statistics: Provisional 2015 cereal and oilseed rape production estimates, United Kingdom*. DEFRA, London, UK. Available at <https://is.gd/ezdryA> (accessed March 2018).
- Department for Environment, Food and Rural Affairs (2018) *The Future Farming and Environment Evidence Compendium*. DEFRA, London, UK. Available at <https://is.gd/kaq2rj> (accessed March 2018).
- Fassler J (2018) What the alt-protein revolution tells us about the future of eating. *The New Food Economy*, 1 March. Available at <https://is.gd/8ckeDy> (accessed March 2018).
- Fitzpatrick I and Young R (2017) *The Hidden Cost of UK Food*. Sustainable Food Trust, Bristol, UK. Available at <https://is.gd/iKoHqI> (accessed March 2018).
- Food and Agriculture Organization of the United Nations (2017) *How close are we to #ZeroHunger?* FAO, Rome, Italy. Available at <https://is.gd/OPHPqp> (accessed March 2018).
- Gilbert N (2012) One-third of our greenhouse gas emissions come from agriculture. *Nature News*, 31 October. Available at <https://is.gd/RYxOsU> (accessed March 2018).
- Government Office for Science (2011) *The Future of Food and Farming: Final project report*. Government Office for Science, London, UK. Available at <https://is.gd/48CcxZ> (accessed March 2018).
- Kearney J (2010) Food consumption trends and drivers. *Philosophical Transactions of the Royal Society B* **365**: 2793–807.
- Kuhlemann K (2018) ‘Any size population will do?’: The fallacy of aiming for stabilization of human numbers. *The Ecological Citizen* **1**: 181–9.
- Laughton R (2017) *A Matter of Scale: A study of the productivity, financial viability and multifunctional benefits of small farms (20 ha and less)*. Landworkers’ Alliance and Centre for Agroecology, Coventry, UK. Available at <https://is.gd/l5euEL> (accessed March 2018).
- National Farmers Union (2017) *The Farmer’s Share*. Available at <https://nfu.org/farmers-share/> (accessed March 2018).
- Nelleman C, MacDevette M, Manders T *et al.* (2009) *The Environmental Food Crisis*. United Nations Environment Programme, Nairobi, Kenya. Available at <https://is.gd/znLneu> (accessed March 2018).
- Nemes N (2009) *Comparative Analysis of Organic and Non-Organic Farming Systems: A critical assessment of farm profitability*. Food and Agriculture Organization of the United Nations, Rome, Italy. Available at <https://is.gd/thlVMO> (accessed March 2018).
- Office for National Statistics (2018) *Labour in the Agriculture Industry, UK*. Available at <https://is.gd/SqCl3M> (accessed March 2018).
- Organic Trade Association (2018) *Organic Market Analysis*. Available at <https://is.gd/wWlso2> (accessed March 2018).
- PigCHAMP (2017) *Benchmarking Summaries*. Available at <https://is.gd/PqHXkp> (accessed March 2018).
- Pimbert M, ed. (2018) *Food Sovereignty, Agroecology and Biocultural Diversity: Constructing and contesting knowledge*. Routledge, London, UK.
- Roseboro K (2011) Leading scientist says agroecology is the only way to feed the world. *The Organic and Non-GMO Report*, 27 December. Available at <https://is.gd/178VOY> (accessed March 2018).
- Sen A (1982) *Poverty and Famines: An essay on entitlement and deprivation*. Oxford University Press, Oxford, UK.

Seufert V, Ramankutty N and Foley J (2012) Comparing the yields of organic and conventional agriculture. *Nature* **485**: 229–32.

Soil Association (2018) *The 2018 Organic Market Report*. Available at <https://is.gd/IR1azE> (accessed March 2018).

Tilman D, Balzer C, Hill J and Befort B (2011) Global food demand and the sustainable intensification of agriculture. *Proceedings of the National Academy of Sciences of the United States of America* **108**: 20260–4.

Tudge C (2016) *Six Steps Back to the Land*. Green Books, Cambridge, UK.

United Nations (2017a) *Global Land Outlook*. United Nations Convention to Combat Desertification, Bonn, Germany. Available at <https://is.gd/93M2v4> (accessed March 2018).

United Nations (2017b) *World Population Forecasts: The 2017 revision*. United Nations Department of Economic and Social Affairs, New York, NY, USA. Available at <https://is.gd/mPaOt7> (accessed March 2018).

Winter M, Lobley M, Chiswell H *et al.* (2016) *Is there a Future for the Small Family Farm in the UK?* Prince's Countryside Fund, London, UK. Available at <https://is.gd/NzdgWh> (accessed March 2018).

World Health Organization (2004) *Human Energy Requirements*. Food and Agriculture Organization of the United Nations, Rome, Italy. Available at <https://is.gd/ZtTYBF> (accessed March 2018).

World Health Organization (2017) *Diabetes: Fact sheet*. Available at <https://is.gd/YitCkV> (accessed March 2018).



## Painting series by Wassili Lepanto

House of the Unknown Poet 1981

**About the artworks:** Rooted in the ecology movement of the 1970s and 1980s, Lepanto's paintings are a call to the 're-greening' of the Earth.

**Higher-resolution versions:** <https://is.gd/ecoartwork>