

# The Coming Famine:

risks and solutions for global food security.

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*Abstract: In coming decades the world faces the risk of major regional food crises leading to conflict and mass refugee movements. This is driven primarily by emerging scarcities of all the primary resources required to produce food – water, land, energy, nutrients, science, fish and stable climates. The paper outlines key factors in emerging global food insecurity and the challenges facing farmers in the coming half century. It proposes a range of solutions.*

We stand at the threshold of what may well be the greatest challenge in history – how to feed humanity sustainably through the mid-century peak in population and demand for food.

## Slide 2 - demand

We're well aware by now there will be around 9 billion people in the world of 2050. However the population will keep on climbing, to 10 or 11 billion by the mid 2060s.

Also, the world economy will continue to grow – and China, India and other advancing economies will be seeking massively more protein food.

Global demand for food will thus more than double in the coming half century.

By 2060 we could be consuming 600 *quadrillion* calories a day.

My first point is that the central issue in the human destiny in the coming half century is not climate change or the global financial crisis.

It is whether humanity can achieve *and sustain* such a harvest.

## Slide 3: constraints

My second point is that agriculture today faces *critical* constraints. Not just one or two, but a whole constellation of them, playing into one another. And serious ones.

Today the world faces looming scarcities of just about everything required to produce high yields of food – water, land, nutrients, oil, technology, skills, fish and stable climates.

Each feeds into and exacerbates the others.

So this isn't a simple problem, that can be treated with technofixes or national policy changes.

It is a wicked problem.

#### Slide 4: water

By 2050, nearly 8 billion people will inhabit the world's cities. They will use about 2800 cubic kilometres of fresh water – more than the whole of irrigation uses today. Desalination may supply some of it but for most of them, it will be cheaper and easier simply to grab the farmer's water.

Then there is the slice of farm water that climate change is already stealing, whether it is rainfall over the great grainbowls, evaporation from storages, shrinking rivers and groundwater or the loss of meltwater from mountain regions. Yes, the Himalayan glaciers *are* disappearing – the only debate is how fast. And the North China Plain *is* running out of water. Those two regions feed 1.7 billion people now and must feed twice that in future.

## Slide 5: lakes

Worldwide, groundwater levels and rivers are dropping as they are pumped dry. Immense waterbodies like Lake Chad are simply vanishing. Despite a wet year, water in our own Murray-Darling Basin is still overcommitted.

A recent study in *Nature* finds that 80 per cent of the world's major rivers are degraded.

IWMI director general Colin Chartres simply says “Current estimates indicate that we will not have enough water to feed ourselves in 25 years time.” (IWMI )

## Slide 6: thirsty race

Today humanity uses about 7,450 cubic kilometres of water a year.

The average individual uses 1240 tonnes of water a year – most of it in the form of food – which is equivalent to an Olympic sized swimming pool every two and a half years.

To put our consumption in perspective, over a lifetime, each of us uses enough water to float the USS Enterprise, a rather large aircraft carrier.

## Slide 7: land

Today almost a quarter of the world's farm land is affected by degradation (FAO 2008), up from 15% two decades ago.

A recent satellite study for FAO found that the world is losing around one per cent (50,000 sq kms) of its farmland annually – due to a combination of erosion, urban sprawl, mining, recreation, toxic pollution and rising sea levels.

If we've already lost 24% and we lose around 1% a year from here on in, you can figure out for yourself how much land our grandkids will have left to double food production on.

That the world may already have passed 'peak land' is suggested by the UNEP graph.

Put another way, between 1990 and 2005, world demand for food grew *15 times* faster than the area of land being farmed.

## Slide 8: megacities

By 2050 the total area of farm land buried under cities will exceed the total landmass of China, and the total area of land diverted to recreation and other non-food activities could rival that of the United States. This is nearly all prime farm land in river valleys and on coastal plains.

The word "development" must now be understood to mean the elimination of food potential. We need to start passing laws to stop it.

One of its most insidious aspects is that every hectare of good land lost on a city boundary has to be replaced with five hectares of marginal country, at risk of drought or erosion, thousands of miles away – adding to food insecurity and destructive land clearing on a massive scale.

However there is worse. Many of these cities will have 20, 30 and even 40 million inhabitants – yet almost no internal food capacity.

If, due to an oil crisis or local war, the endless river of trucks carrying food failed to arrive even for a week or two, what would their citizens eat? They would starve within days.

We have designed our great cities as death-traps.

### Slide 9: nutrients

The world is losing nutrients at every link in the chain between farm and fork. On farm it appears anything up to half of applied nutrients can be lost into soil, water and the environment.

The resources of mineral nutrients that sustained the agricultural surge of the last 100 years are starting to fail. When Canadian Patrick Dery applied Hubbert's peak theorem to phosphorus he found, to his dismay, we had passed it in 1989! We have already passed peak oil and will pass peak gas shortly. Together these spell growing scarcity and far higher

prices for the fertilisers that sustain all advanced farming systems.

Most of the world's farmers will simply be unable to afford them.

### Slide 10: waste

Then there's waste. In developed countries we trash from a third to half of all food produced, in developing countries we lose similar amounts post-harvest. All told, the Stockholm Institute calculates we waste 2600 out of every 4600 kilocalories harvested.

Put another way, half the achievements of the world's farmers are going to landfill.

While a billion starve, we waste food enough for 3 billion.

Our grandparents would say we were idiots. And they'd be right.

### Slide 11: peak oil

Global peak oil has already happened, according to the International Energy Agency. It has certainly occurred in the US, in Australia, Britain and in 49 out of 65 of the world's oil producing regions.

Yet 60 million new cars will hit the world's roads this year.

Just as farmers have little control over who snatches their land, water and other assets, they have little control over

who snatches their fuel. By 2040 what fossil oil is left will probably be reserved for the military and everyone else will have to get by as they can.

The average citizen of a developed country eats the distillate from 66 barrels of oil a year, such is the dependency of modern food systems on fossil fuels.

So one of the most pressing issues to solve is where the fuel to power the tractors, the pumps and the trucks, trains and ships that move the food will come from in future. It cannot come from the farm: to do that would lower world food output by 10 - 30 per cent, right when we need to double it.

We do not know when the next oil crisis will come: next week, next year or next decade. But come it will. Prices are already over US\$100 a barrel and \$200 or 300 is regarded by many experts as possible.

We urgently need to convert the whole of the world's advanced farming systems to another energy source, algal biodiesel maybe. Or hydrogen. Or solar-electrics. But I see little sense of priority from governments.

### Slide 12: fisheries

At the same time fisheries scientists report a third of world fisheries are in a state of collapse (Worm et al 2007). The majority could be gone by the 2040s they warn.



FAO (2008) says “the maximum wild capture fishery potential from the world’s oceans has probably been reached” and the same applies to freshwater.

If we cannot double fish production as food demand doubles, then we will have to get the extra 100 million tonnes of meat from land animals or fish farms. And this will require a billion tonnes more grain and 1000 cubic kms of extra fresh water.

At the same time FAO expects global meat demand to increase by 185mt by 2050.

Just to put the size of the farming challenge in perspective, we’d need to discover *three more* North Americas to feed all these animals.

### Slide 13: climate

This is all happening in a time of climate change. “Our crops are adapted to climates which are about to become extinct,” is how Cary Fowler, who runs the Svalbard Seed Vault, sums it up.

The UK’s Hadley Centre thinks drought could regularly affect 40 per cent of the planet’s land area by the end of this century.

Their soil moisture projection suggests that regions once thought to have big farming potential, like Brazil, southern Africa and the Indian grain bowl, may prove unreliable.

The International Food Policy Research Institute warns of a 30% drop in irrigated wheat in Asia and 15% in rice due to climate factors. The World Bank thinks African productivity could halve and India's drop by 30 per cent.

Australia is already regarded as “the canary in the coal mine” – experiencing reduced food potential from both extremes of drought and floods as a result of climate change. Failure to adapt to these changed conditions means we will be importing grain by 2050, warns CSIRO.

#### Slide 14: climate scenarios

Translating that to human impact: without radical change in global food systems a 2 degree rise in temperature means the Earth may barely support its present population, says Oxford's Dr James Martin.

A 4 degree rise – which we are on track to achieve – could eliminate up to half of humanity.

I take this to indicate current food systems and diets are not sustainable under the changed conditions: we have to reinvent both.

#### Slide 15: challenge

This is the size of the challenge facing the coming two generations of farmers.

It is to double the global food supply using half the water, on far less land and with increasingly depleted soils, without fossil fuels, with scarce and costly fertiliser and chemicals, under the hammer of climate change.

But it also represents enormous opportunity for efficient and flexible farming countries like Australia.

It is a chance for us to be a world leader in something we are really good at.

### Slide 16: R&D

The snag is that farmers will have to accomplish this miracle using less science and technology.

On top of the scarcities of land, water, energy and nutrients agriculture is driving headlong into a huge technology pothole.

This is the result of decisions by national and regional governments worldwide, by aid donors and academic institutions, to slash resources for agricultural research and extension over four decades.

In Australia, in the US, Germany, Britain, France, Japan and China too we have been hacking down agricultural research. Only recently we saw our own Productivity Commission calling for even more cuts.

In the year 2000 the rich countries spent just 1.8 cents in every research dollar on ag research, so unimportant has sustaining the food supply become to them.

Today the world spends about \$40 billion a year on agricultural science.

And it spends \$1500 billion a year on weapons.

The effects of all this are plain in declining world farm productivity. Crop yields are rising at barely half what is needed to keep us fed in the long run.

The global decline in agricultural R&D in the past four decades means less new technology will be available to farmers between here and 2030 than in the past two generations.

I believe it is now time to end the silly argument over which is the best farming system to feed the world – technologically-advanced broadacre systems, or efficient organic smallholder systems. Each produces about half the world's food. We cannot abolish one and promote the other without causing either a food or a social catastrophe.

Now is the time to bring both strands of agricultural thought together to create the efficient, low-input, high-yield *sustainable* farming system of the future.

This is the new eco-agriculture, which we have yet to invent.

Creating this eco-farming is, I'd argue, humanity's most urgent task.

This new food producing system has to be science-based. It has to be low input. It has to replenish, not destroy. And it has to work for farmers large and small, everywhere.

### Slide 17: conflict

If we fail, the consequences will be profound.

Modern wars are often driven by scarcities of food, land and water. Dáfour, Rwanda, Eritrea, the Balkans were all destabilized, at root, by squabbles over these resources. Going further back, the French and Russian civil wars both grew out of bread crises. We *know* that hunger breeds war.

The UK Ministry of Defence – which developed this threat map – America's CIA, the US Center for Strategic and International Studies and the Oslo Peace Research Institute all identify famine as a potential trigger for revolution, government collapse and wars, possibly even nuclear.

### Slide 18: food prices

Underlining the point: the riots that overthrew governments in Egypt and Tunisia recently both began with public protests over food prices, now at their highest level in history.

However the good news is that many wars can also be avoided – by meeting the rising demand for sustenance, despite the constraints I have identified.

## Slide 19: refugees

Refugee and migrant numbers have risen sharply in recent years.

Future famines in any significant region – Africa, India, Central Asia, China, Indonesia, Middle East or any of the megacities – will confront the world with tidal waves of tens, even hundreds of millions of refugees, swamping their neighbouring countries.

In future, even places that deem themselves physically remote like Australia may face refugee tides in the millions or tens of millions, bringing profound change to our society.

Let there be no doubt that solving the challenge of global food insecurity is the paramount concern of all nations and all people in the coming two generations.

So what are the solutions?

Obviously they are many and detailed, so I shall confine myself to the most important.

## Slide 20: solutions

### 1. Redouble Knowledge

We need to redouble the global investment in agricultural science. In my estimate we should lift the total agrifood R&D spend to at least \$80 billion, twice what it is today.

Then, for every research dollar we need to spend another dollar getting the knowledge into the hands of the world's 1.8 billion farmers and food processors.

We must generate the greatest knowledge sharing effort in history – to reach not only farmers, but also all consumers, because farmers alone will not be able to solve this challenge.

Using the wonderful mass communication and media systems now available and ramifying through the world, I believe this to be completely achievable.

And where is the \$160 billion to come from?

Agricultural science IS defence spending.

Just ten per cent of the world's current defence budget would secure both a sustainable food supply and enhance the prospects of peace everywhere.

## 2. End Waste: re-use

An easy way to improve global food security is to reduce the colossal waste of half the food we currently produce. This will also spare water, nutrients, energy, soil and human labour.

However it means extensively redesigning both our diets, and the food production and distribution systems that satisfy them. It means educating nine billion people to a new respect for food.

## Slide 21: vegies in sky

It means greening our mighty cities, mining and recycling the vast volumes of water and nutrients they presently collect, purifying them and designing entirely new urban-based food production systems.

These will turn what we now regard as organic waste back into food, fuel and a great many other essential things.

It will involve growing large quantities of fresh vegetables within urban areas by hydroponic, aquaponic and aeroponic methods. We need to design this new urban permaculture from scratch and incorporate it into the buildings, landscapes and social milieu of our mighty cities.

## Slide 22: biocultures

It will involve creating an entirely new industry that uses organic waste to produce vegetable, microbial, fungal and animal cells in biocultures and turns them into healthy and novel processed foods, but also into fuel, fertilizer, stockfeed, pharmaceuticals and fine chemicals.

So let us declare a World War on Waste.

Let us design farming and food systems that do not waste or, if they do, that then reuse.

### 3. A New Diet



We need to refashion the world diet - to one that involves far less energy, land, water, nutrients and pollution.

To one that doesn't actually kill half the people who eat it, as does our present one.

Sound hard? Not really. It means returning to the sort of light, balanced nutrient intake our grandmothers would recommend.

### Slide 23: 23,000 new crops

One way is to double the amount of vegetables in the diet, many produced in these new urban systems using recycled water and nutrients. Vegetables produce far more food per hectare, per megalitre of water, per tonne of fertiliser or per litre of fuel than other crops or livestock.

There are 23,000 edible plants which we do not farm or eat to make this a culinary adventure as well as a global awakening and a health revolution. The richness of nature has scarcely been tapped in this regard and our shops, supermarkets and restaurants are poor in diversity compared with what they will become.

### Slide 24: rangelands

Humanity will continue to want to eat meat. But with the rise in grain and energy prices and the drying of the world's grain bowls, livestock production will refocus on the world's grasslands and rangelands.

Future meat will be clean, healthy, natural and largely organic – by popular demand.

And it will be much more expensive, returning a better living to graziers and herders.

It will use techniques like 'precision pastoralism' to ensure it is sustainable.

It will bring new growth and regeneration to the world's savannahs and their wildlife.

It will lock up billions of tonnes of carbon.

We can also farm small parts of the deserts, using new systems that grow food, feed and fuel from sunlight and seawater.

To achieve all this we have to change the attitudes of 8 billion urban consumers towards food and farming.

### Slide 26: food year

This calls for the world's most ambitious educational campaign – to install one full year, a food year, in every junior school on the planet.

A year in which every subject – maths, language, geography, science, society and sport – is taught through the lens of food, how precious it is and how it is produced, where it comes from, how to eat safely, thriftily and healthily. How to help ensure it never fails.

Teaching food is acceptable in all cultures, races and creeds. Teaching respect for food and how it is produced is equally so. The means already exist to share these principles and educational courses universally.

We must also enlist the food processing industry, the supermarkets, the cookbook writers and nutritionists, the TV chefs and restaurants and the health departments to promote the same universal messages.

Eat well but eat less. Eat more vegetables and less energy-intensive foods. Choose foods that spare our soil and water. Be happy to pay more for such good food, so our farmers can protect the precious environment that produces it.

### Slide 27: pay more

#### 4. Pay more for food

Today we enjoy the cheapest food in human history. It is a third the price our grandparents paid for it, half what our parents paid.

But it is destroying landscapes, water and farming communities worldwide, killing consumers and causing colossal waste.

It is too cheap to last.

It is imperative in the coming decade that we do two things:

First, abolish all trade barriers so food production can go where it is most efficient and

Second, start paying all farmers a fair income.

The prices that globalised food chains now pay farmers will end up destroying agriculture, its resource base and its communities. We are already seeing its worst effects here in the 'milk war'.

This will hollow out global food security.

Almost everyone in society now receives fair pay – except farmers. This has to end if we want to eat in future. There are many ways to do this, which I don't have time to discuss.

The coming famines of the mid-21<sup>st</sup> century cannot be solved by governments, by scientists or by farmers alone. We need a change in behaviour by every person on the planet, especially in rich and urban societies.

This is a challenge at the species level.

It will decide, once and for all, whether or not we are fit to bear the title *sapiens*.

Farmers not only grow food. Our 1.8 billion farmers – mostly women – also manage half the world's land, three quarters of its fresh water, a third of its atmosphere, much of its wildlife.

They need society's help to do so.

And they need fair incomes to do so sustainably.

Farmers are today the most important human beings alive.

The world has forgotten this.

It needs to be reminded.

Delivering new food systems and technology to all the world's farmers, paying fair prices and changing our eating habits is a matter of both national and global urgency.

### Slide 28: Australia's role

Given our history, our skills and our resilient and generous character, Australia should lead the world in this endeavour.

This is a shining challenge, both inspiring and well within our powers.

I believe it is, once more, Australia's destiny to serve humanity in this way... and help to avert The Coming Famine.

### Slide 29: Thank you & TCF