

The Coming Famine:

the risks to global food security.

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Abstract: In coming decades the world faces the risk of major regional food crises leading to conflicts and mass refugee movements. This is driven primarily by emerging scarcities of all the primary resources required to produce food. The paper outlines key factors in emerging global food insecurity and proposes some solutions.

Slide 2

Barring wars or major accidents, there will be about 9.2 billion people in the world of 2050 – but they will eat as much food as 13 billion at today's nutritional levels.

Overall demand for food is expected to more than double by the mid-century.

The main issue confronting humanity in the next 50 years is not climate change – it is whether humanity can achieve *and sustain* such a harvest.

Slide 3

Current world food output is keeping pace with growth in human numbers - but not with growth in food demand. This gap will widen as more societies undergo economic development and switch to western diets and 'fast foods' rich in meat, dairy and oilseeds.

Increased production of biofuels is bound to displace some food production, whether it competes for land, water, fertiliser, pesticides or other farming inputs. The World Bank attributed most of the recent surge in food prices to grain being burnt to power motor vehicles. However other powerful factors are moving in the background.

Slide 4

For the first time in history, urban demand for water is outpacing farm demand, as city users outbid irrigators. By 2050 cities will consume more than half of the world's available fresh water. This could be as much as 2400-2800 cubic kilometres, about the same as we use to grow food with in irrigation today.

This, combined with global warming, could cut supplies to the world's irrigators.

3 billion people face acute water scarcity and another 5 billion moderate scarcity. (IWMI)

An example is the Indo-Gangetic foodbowl which feeds 1.3 billion. As the Himalayan Water Tower melts, the great rivers will rise, then empty, bringing potentially catastrophic reductions in the size of the harvest in one of the world's most populous regions. The signs of this are already evident.

Groundwater levels and rivers are dropping worldwide as they are pumped dry. IWMI director general Colin Chartres says "Current estimates indicate that we will not have enough water to feed ourselves in 25 years time, by when the current food crisis may turn into a perpetual crisis." (IWMI 2009)

Slide 5

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

The world is currently losing about one per cent (about up to 50,000 sq kms) of its farmland annually. If we don't stop this, two thirds of our farming and grazing lands will be useless by mid-century.

Cities are also devouring the world's best farm lands both for urban sprawl and recreation. The urban footprint is now half the size of China or the US. By 2050 it will be larger than either country. The word "Development" must now be understood to mean the permanent loss of food production.

Slide 6

The world is hemorrhaging nutrients at every link in the chain between farm and fork.

We passed 'peak phosphorus' in 1988 (Dery 2008). From now on demand for nutrients to grow food will progressively outrun the discovery and development of new mineral resources (see table). Real fertiliser prices will soar.

The world is currently wasting up to 80-90 per cent of its applied nutrients, which leach off farm or are lost in the food chain or thrown away.

Nutrient pollution pollutes many water bodies, preventing aquaculture. We are pumping around 150 million tonnes of nitrogen and 9 million tonnes of phosphorus into the biosphere that wasn't there a century ago. This threatens the entire planetary nutrient cycle and food webs everywhere.

Slide 7

The world will pass peak oil and gas in the coming decade 2020, according to the IEA. Global demand for petroleum is already outstripping the rate of new discoveries. This will inevitably drive up energy and fertiliser prices in the longer term.

Since 97 per cent of the world's nitrogen fertilizers are made using natural gas, which is also due to peak shortly, a potential N scarcity is on the cards too.

By the 2040s it is very unlikely we will be using fossil fuels in agriculture. Just what we will use is not yet clear – but our present advanced farming systems cannot be sustained without very large inputs of energy.

Replacement of farm energy with home-grown biofuels will cut food output in developed countries by about 10% directly. If farm biofuels were also used to transport food to cities, then 30% of the developed world's farm land would have to be turned over to fuel production. This suggests biofuels may have to come from non-farm sources.

Slide 8

International funding for ag research is about \$30 billion globally and has been stagnant in real terms since the early 1970s - when the population was half what it is today.

In agricultural science leaders such as the US, Australia, Germany, Britain and China research is actually shrinking.

Crop yield increases have declined sharply in recent years and no longer keep pace with growth in world demand for food.

GM crops, while of value, have not yet added anything to the total food supply: we will need more than biotechnology to avert famine, yet farmers worldwide are receiving less new technology to do it.

Slide 9

29 per cent of world fisheries are in a state of collapse according to Boris Worm and colleagues (2007). Most of them could be gone by the 2040s they warned.

Plagues of jellyfish in the world's oceans signal the impact of overfishing and nutrient pollution, while carbon emissions are turning the seas acidic, threatening entire marine food chains.

FAO (2008) states "the maximum wild capture fishery potential from the world's oceans has probably been reached" and "In the case of inland fishery resources, there is widespread overfishing."

If we cannot double the ocean harvest as food demand doubles, we will have to produce 100 million tonnes more meat from land animals, requiring a billion tonnes more grain and 1000 cubic kms of fresh water.

Slide 10

Regular drought could grip 40 per cent of the planet's land area by the end of this century warns the UK's Hadley Centre for Climate Prediction.

Their soil moisture projection indicates that regions once thought to have increased farming potential, such as Latin America, southern Africa and the Indian grain bowl may prove unreliable.

The International Food Policy Research Institute has just warned of a 30% drop in irrigated wheat yields in Asia and 15 per cent in rice yields. The World Bank says there could be a potential loss of up to 50% in African food productivity and 30% in the Indian subcontinent due to climate change.

Australia is already regarded, justly, as "the canary in the coal mine" – experiencing reduced food potential as a result of climate change, which in turn is linked significantly to the burning of coal and overclearing of land.

Slide 11

Ecological overshoot is a term coined by the Global Footprint Network to describe how we are withdrawing more resources from the planet than it is capable of replacing in one year.

The GFN estimates we now consume the total productivity of 1.3 Earths in food, water, energy and other resources.

If the trend continues, they say, we will consume 2 planet's worth of production by 2050 – a situation which is totally unsustainable.

And , sobering thought, if every person on Earth lived and ate like an Australian we would need not one, not two, not three but more than FOUR Planet Earth's to support them all.

If the GFN is correct then the modern diet and agricultural systems that support it will exceed the world's bio-capacity by the mid century.

Put simply, today's food production systems and diets are not sustainable, and we must reinvent them.

Slide 12

The farming challenge facing the coming generation is immense.

It is to double the global food supply using half the water, far less land area and exhausted soils, without fossil fuels, with very costly fertiliser, with limited technology, spreading diseases and pests, under the hammer of an erratic climate.

Slide 13

The consequences of failure are profound.

Most recent wars have been driven by scarcity of food, land and water. Dafour, Rwanda, Eritrea, the Balkans were all destabilized, at root, by these interlocking scarcities.

The UK Ministry of Defence - which developed this threat map - the American CIA, the US Center for Strategic and International Studies and the Oslo Peace Research Institute all recognise famine as a potential trigger for conflicts and even for possible nuclear wars.

The wars of the C21st are less likely to be global conflicts with sharply defined sides and huge armies than a scrappy mass of failed states, invasions, rebellions, civil strife, insurgencies, terrorism and genocides driven by competition for scarce primary resources.

This can only be forestalled by humanity managing successfully to meet the rising demand for sustenance, despite all the constraints I have identified.

At present we spend about \$30 billion a year on R&D to increase the global food supply and \$1300 billion – fifty times as much – on developing and buying weapons. So we have the money to fix the problem, if we wanted to.

Slide 14

Refugee and internally displaced person numbers have risen sharply in recent years.

Famines in any significant region – Africa, India, Central Asia, China, Indonesia or the Middle East – will confront the world with tidal waves of tens, even hundreds of millions of refugees.

Sea level rise alone could displace 50 million people by the end of this century.

These movements will exceed the largest migrations of history.

Even places as physically remote as Australia could face refugee tides in the millions, threatening profound change, even destabilisation, to our society.

Slide 15

The easiest way to increase food availability is to end the waste of half of all the food we currently produce.

The shopping basket illustrated shows the amount of food thrown away by the average western family in a month.

Ending the waste will also save water, precious nutrients, energy and soil.

However it means extensively redesigning our diets, and food production and distribution systems.

Slide 16

Sustaining food production through the mid-century peak in human demand and numbers is the global scientific challenge of our era.

More urgent even than global warming or the economic crisis is the need to deliver to farmers the new knowhow and technology they need to maintain food production in the face of all the constraints described.

We need to lift our current investment in agricultural R&D fourfold – doubling the research effort and adding a massive endeavour to disseminate new knowledge to both farmers and consumers.

This can be funded by levying the global weapons spend of \$1.3 trillion just 10%. This will make the world safer, healthier and more peaceful at the same time.

Young women in all cultures are refusing to marry and have children. If we support them, they can reduce the global population peacefully and voluntarily. We must support the right of individuals in all cultures not to reproduce, if they so wish.

We need to recycle all water and all nutrients and create new food production systems based on hydroponics, 'biofarming' and cell culture.

Slide 17

The coming global famine cannot be solved by governments and scientists alone.

It requires a change in personal behaviour by every person on the planet, especially in rich societies.

We will have to choose a global diet that uses far less energy, water, land and nutrients. This is a diet containing about 50% more vegetables than today's western diet. (It will still contain meat and dairy, but in smaller quantities and at a much more profitable return to growers)

There are several thousand "undiscovered" indigenous vegetables to make this a culinary adventure as well as a global awakening and a health revolution.

They are suitable for traditional horticulture, broadacre irrigation and hydroponic urban farming systems. They use vastly less land, water and nutrient to produce much larger volumes of food.

Meat production, I predict, will go back to the rangelands where it will be lower in energy intensity, organic and more acceptable to changing social mores than today's 'factory meat'.

Slide 18

Famine, war and poverty will not be solved only through sharing knowledge that enables people to sustain their own food needs. The economic miracles of modern China and India were built on agricultural knowhow.

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 and a third of its atmosphere.

Farmers are the most important human beings alive. The world has forgotten this.

Getting new farming knowledge and technology to all of them is now a matter of national and global security: to protect Australia and the world from the wars, insurgencies and refugee floods which will be triggered by major famines.

Agriculture and food research must be seen as defence spending.

Australia should be a world leader in all this.

Slide 19

The outlook for Australian agriculture and trade over the coming decades is very bright, despite the climate. However our greatest opportunity and responsibility is to export agricultural science, technology, skills and knowhow to a world that will desperately need them.

The global outlook is one of increasing food insecurity, risk of regional famine and conflict. No country is immune from this.

The farmers, agricultural scientists and policymakers of Australia have a *vital* role to play in the human destiny – to help avert what otherwise may become the worst famines in history.

They need vastly more support from governments and the community than they are getting.

It is a shining challenge, both inspiring and within our capabilities.

I believe it is Australia's destiny to serve humanity in this way.

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