

Huge shift in what we eat

Julian Cribb

The world diet in 2062 or 2112 will be as unfamiliar to most people today as our own cosmopolitan diet of fast food and ethnic cuisines would be to our great grandparents in 1912. The new foods will be the result of fierce demand and resource pressures on food worldwide, astonishing new technologies, and emerging trends in diet, farming, healthcare and sustainability.

With food-related diseases implicated in nearly half of all deaths across Australia and the world, our present "killer diet" is unlikely to last long, as society - and governments especially - awaken to its true costs. And with global warming of five to six degrees Celcius on the cards by 2100, a great many familiar foods are likely to decline or disappear.

As transport fuels become scarce and costly, there will be a fresh focus on locally produced foods. If cities and the resources sector continue to take water and land from farmers, and supermarkets continue to punish them economically, much of our future food may be grown in factories, rather than on farms. If technology continues to snowball, it will give rise to a host of novel foods we can barely imagine today.

While all that may sound a little ominous, the diet of the future will also be vastly more diverse, interesting, healthy, resource-efficient and creative. It will surprise, and even shock, many who regard food as a tradition, an unchanging constant in their lives.

With 10 billion consumers eating a better diet than today, demand for food is likely to double by the 2060s. At the same time, scarcities of water, arable land, oil and petrochemicals, fertilisers and fish, combined with unstable climates, will make growing food by conventional means extremely difficult, costly and often unsustainable. This will drive a rethink of how we farm, what foods we produce and prefer, and indeed, the entire social relationship with food.

Among the boom food industries of the coming half century are aquaculture, algae farming, novel fruits and vegetables, urban agriculture and biocultures. These will yield a diet significantly kinder to the planet, more healthy and delicious for the consumer, more diverse and rewarding for the producer and investor, and less costly to governments in terms of the health budget.

Farmed fish and algae

When the ocean fish catch peaked in 2004 (Food and Agriculture Organisation 2010), it became plain that most of the world's table fish will have to be farmed rather than wild-harvested. Worldwide aquaculture now produces about 40 million tonnes of fish and 15 millions tonnes of

water plants a year - but this is only a shadow of its potential.

For example, CSIRO's Dr Nigel Preston says 1.5 million hectares of land in northern Australia has been assessed as suitable for farmed fish production. Fish farms today yield five to 10 tonnes of prawns or barramundi to the hectare every year - so there is potential for an aquaculture sector many times larger, even, than our beef or sheep meat industries, provided the feed sources exist to support it.

One reason fish farming is set to boom is that fish convert feed into meat about twice as efficiently as large land animals, and use much less oil and carbon to do so. In a world where protein will be both scarcer and more expensive, farmed fish is an appealing option - so get ready for an explosion in choice: fish, crustacea, shellfish, echinoderms (like urchins and sea cucumbers), jellyfish, seaweeds and a host of aquatic things many people have never heard of.

Feeding these fish on grain will probably not be economic, quite apart from the likely cost to the planet in soil erosion and carbon pollution - so this in turn will lead to a boom in the growing of water plants, large and microscopic.

In future, huge algae farms will produce food for people, feed for animals, biofuels for transport, pharmaceuticals, plastics and fine chemicals - and themselves will be fed on the vast stream of nutrients emitted by the world's cities, as they begin to recycle food waste, organic waste and sewage. In the United States, the Obama government is already ploughing billions of dollars into algal biofuels research for defence forces. In Australia, James Cook University is pioneering new algal farming techniques, including the clever idea of using the waste CO₂ emitted by power stations as a feed source. Algae can be farmed in tanks, vessels or ponds on waste land or roofs, and even in large floating containers in the oceans, without competing against agriculture or wilderness.

When all is said and done, algae are just water plants, and can be turned into delicious and healthy foods as readily as wheat, rice or any other crop. There isn't an algae bar at the supermarket yet - but watch this space.

Artificial meat

While foodies might sneer at the idea of artificial meat, European and Japanese scientists are hard at work developing it. Last year, a Dutch university produced the world's first synthetic sausage, and the first synthetic hamburger is due this year. Cultured meat is produced by growing animal stem cells in a glass dish and feeding them on the right nutrients to become muscle cells. The holy grail of this research is to endow the artificial meat with the same flavours, textures and other qualities as normal meat. People who eat crab sticks, chicken nuggets, sausages or pies today will probably eat cultured meat just as happily in future, its developers believe.

Cultured meat takes vastly less soil, water, fertiliser and carbon to produce than conventional meat. With megacities of 30-40 million people and 10 billion to feed, supplying all the world's meat from "traditional" farming and grazing systems is unlikely to be possible without turning entire landscapes into deserts. Another factor is consumer concern over animal welfare.

Traditional meats will still be available by mid-century, but prices tags of \$100-\$200 a kilogram will probably ensure people eat them with far more respect, restraint and appreciation - and farmers earn a more rewarding income.

Biocultures

Cell culture methods currently used in medical research will emerge as a major source of healthy food. Cells from plants, animals, fungi and microbes can be cultured en masse in large steel vessels - known as bioreactors - and turned into edible, soundly nutritious and even delectable foods.

More importantly, novel foods will be designed that perfectly suit the dietary needs of the

individual consumer - and protect them against heart disease, diabetes or cancer based on genetic analysis of their personal risk. Those tempted to deride such "factory foods" might think again, if eating them means an extra 10 or 20 years of healthy life.

By 2060, the world's cities will cover an area of the planet as large as China (9.6 million sq km), consume half the available fresh water and discard enough food and nutrients to feed five billion people. If they do not meet at least part of their own food needs, these cities will be in extreme danger of famine from transport or climate crises. The need to sustain a local food supply for a giant city, combined with the need to recycle nutrients and water, will drive the development of the new bioculture food industry.

Urban farms

The need to feed the megacities will also usher in a new era in urban agriculture. This will range from the very high tech - glass skyscrapers producing vegetables, fruits, fish and small livestock by largely hydroponic methods - to the industrial production of fresh foods on urban roofs and walls, to a renaissance in backyard, balcony and public food gardens. This trend is already in evidence around the world, especially in the US and Europe, where it is forcing cities to revoke ordinances that prohibit urban farms.

Hospitals are already culturing fresh vegetables on their roofs to feed to patients. Trendy restaurants offer patrons salad greens gathered just 15 minutes ago. Supermarkets are exploring ways to tempt consumers with truly "fresh" produce, harvested from the roof today, rather than cold-stored for days and transported at vast cost in energy and carbon emissions. Cities like Chicago are reinventing themselves around fresh food and food tourism. Cities like Detroit are turning old factories into farms. Fish and vegetable farms are sprouting in Manhattan. Columbia University ecologist Dickson Despommier envisions towering translucent vertical farms, architectural wonders to green and adorn the skyline of the future city.

As this trend grows, it has the potential to become something much larger. To avoid waste in a century when all resources will be scarce, the Australian concept of permaculture (permanent agriculture, entailing the recycling of water, nutrients and energy using natural principles) will apply to entire cities. Permaculture will become a first principle of sustainable urban design, and these green cities, alive with vegetation, fresh food, birds and insects, will gradually replace the soulless concrete and glass conurbations of today.

A feast of new foods

Humanity subsists on only a few dozen different plants. Yet Tasmanian agricultural scientist Bruce French is compiling a database that already lists 25,000 different edible plant species. Australia, for example, has about 6100 edible native plants, of which we regularly eat just five or six.

Modern humans, in other words, have barely begun the exploration of planet Earth's culinary potential. We have undoubtedly forgotten much that our Homo erectus ancestors knew about healthy and interesting diets - indeed, the modern food system is narrowly founded on half a dozen different grains, a dozen animals and 60 or so fruits and vegetables, despite the illusion of diversity in the packaged foods on supermarket shelves.

Many edible plants which don't feature in the modern diet are still consumed by small indigenous groups. Many are vegetables - and can be produced using far less soil, water, energy, carbon and fertiliser than grains or meats, which means they will inevitably make up a growing proportion of the future diet.

The untapped diversity of edible plants also offers the prospect of new industries and jobs, which will help employ the billion or so people driven out of traditional agriculture in coming decades by massive supply-chain concentration and the market power of giant supermarkets and food firms.

New foods will also emerge from the biotechnology laboratories of the world - more nutritious grains and vegetables, faster-growing animals and fish, better climate-adapted strains. These will

only be adopted into the world diet, however, at the rate and extent sanctioned by consumers. This, so far, has proved a stumbling block, with opposition to genetically modified foods being developed in the US and Europe, as well as in countries like India. The issue will probably turn on the ability of food and agribusiness companies to develop novel foods which have real benefits for consumers like disease prevention, rather than just bigger profits.

Other foods

Insects, both land and aquatic, are increasingly seen as an easy, reliable new food source. About 1400 species of insects are on the menu worldwide. Insects take up little room, can be fed on food waste, are low in fat and high in calcium and iron - but are not a traditional part of the Western diet, and much will depend on consumer preferences and fashions, and the willingness of cooks and food companies to promote them as food.

Plagues of jellyfish and algae in the world's oceans are a direct result of humanity liberating vast amounts of nitrogen and phosphorus into the biosphere, and of overfishing of the species that normally prey on them. Having polluted the seas, bays, lakes and estuaries, the attraction of harvesting these products of the simplified ecosystems we have created becomes obvious.

Reinventing farming

Worldwide, the farming system that has supported us for 5000 years is being reinvented to cope with looming shortages of land, water, oil and fertiliser, and changing climates. This will continue throughout the century. By 2100, it is probable that about half the world's food will come from modern eco-farms (both organic and high-tech), and half from novel industrial and urban systems outlined above. The farmed food will be a lot more expensive, reflecting the scarcity of the resources needed to produce it and the very high skills required of farmers to do so sustainably. Robotics will provide the next phase of the precision agriculture revolution.

Where it is economic, food will probably be produced in the world's deserts, using solar energy to heat and cool huge greenhouses and extract freshwater from the sea or saline groundwater. Such systems could well be the salvation of regions such as the Middle East, Western China, Central Asia and North Africa.

Climate change will penalise food production in the tropics, subtropics and lowlying coastal areas, but by 2100 will begin to open new lands for grain and grazing in the high north, with Canada and Siberia poised to emerge as food superpowers of the 22nd century. Greenland and even the fringes of Antarctica may become hothouses of specialty food. Agriculture will enable the restoration of tropical forests in Latin America, Africa and Asia and the creation of havens to protect endangered animal and plant species. At present, the biggest threat to global biodiversity is human eating habits.

These emerging trends in food will surprise and even appall some people - and excite and motivate many more. Like our homes and clothes, our food is not frozen in time and, while our diet respects tradition, it is constantly in pursuit of novelty. Driven by necessity and impelled by our urge to discover new things, the next century of food will be the most adventurous and interesting in the 10,000-year story of civilisation.

*Julian Cribb is an Australian science and agriculture writer and author of *The Coming Famine: the global food crisis and what we can do to avoid it* (UCP 2010). He lives in Canberra.*

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