

THE ONLY WAY IS UP

Global food prices are rising because traditional farms are struggling to produce enough food for the world's population. **Rachel Sullivan** asks whether moves to bring farms into the cities are feasible, and finds that first we may have to rethink our idea of how - and where - food is grown.

VERTICAL FARM DESIGN BY OLIVER FOSTER,
UNI OF QUEENSLAND
(IMAGE COURTESY WWW.VERTICALFARM.COM/DESIGNS)



AS THE WORLD'S food bowls turn to dust and blow out to sea, and our ever-expanding cities cover once productive farming land with houses, the days of growing fruit, vegetables and livestock in the country may be numbered. And with populations continuing to grow unchecked, some have begun to wonder just how society is going to feed itself, even in the near future. For some visionaries, the answer is simple: bring the farms into the cities, and with space at a premium it looks like we will need to look up to see the farms of the future.

Professor Julian Cribb, author of *The Coming Famine*, believes that 2008's global food crisis was a timely forewarning of what could be expected as civilisation runs low on water, arable land and nutrients, and experiences soaring energy costs.

"By 2050 more than 8 billion people (more than three-quarters of the projected human population) will be living in places where they are totally without the means or knowledge of how to feed themselves," Cribb says. "Unless we act, our cities will be giant death traps at the mercy of even minor glitches in regional or global food supplies."

The consequences, he says, would be dire. "It doesn't take much for society to break down when resources are scarce: since the 1990s two thirds of all conflicts occurring around the world have been caused, at least in part, because of a shortage of food, land or water." In *The Coming Famine*, he also argues that genocides increasingly represent an attempt by one group to eliminate the access of others to those key resources, and says that cannibalism is another unpalatable, but predictable consequence of extreme food shortages. "This hasn't been a problem in the past because most food production took place within easy reach of cities, however they are now very vulnerable, as this generation will find out."

Cribb believes that the key to avoiding global famine is to bring food production closer to where it is consumed, that is, back into the city, radically reducing the distance – and transport costs – of bringing food from paddock to plate.

"Cities are enormous traps for water and

nutrients, which are mostly used once then discarded either into landfill or irretrievably into the sea. What most people don't realise is that the world is running out of nutrients as fast or faster than oil."

Intelligently recycling those nutrients back into agriculture or urban horticulture is essential if we are to stave off disaster, he says. But to meet demand, future farmers will also need to double food production using only two-thirds of currently available water, using more degraded soils, limited space, and scarcer nutrients in the form of chemical fertilisers, as well as facing other threats that will come with climate change.

"Urban farmers of the future, who will primarily grow vegetables, will play a much larger role in the global diet," Cribb comments. "Intensive urban agriculture is an entirely new industry and will need a new professional who can grow food on the roofs and sides of buildings" – think Hanging Gardens of Babylon updated for the digital age.

"There is, however, no one size fits all solution to feeding 11 billion people," he says. "What is required is a multi-strategy approach – some of the solutions will be high tech, some will be clever, many will involve more hands-on labour from people – a resource of which there'll be an abundant supply in a world of 11 billion people."

Call to arms

About 15 per cent of the world's food is currently grown in urban areas, according to the US Department of Agriculture. However, this figure is expected to increase as food prices rise, urban populations grow, and environmental concerns mount. The trend toward city farming is already big in Canada and Europe and is gaining ground in the US amid escalating concerns about the environment, pesticides and food safety in general. Turning an old parking lot into a working farm not only helps reduce a city's carbon footprint but can also generate revenue for rundown areas.

Since they sell directly to their communities, city farms don't depend on transportation and are relatively immune to oil price fluctuations, advantages that are now gaining traction as 'eat local' initiatives in rich countries. Low-tech

allotments and community gardens are sprouting up in cities and urban areas all over the world, including Australia, particularly in densely populated and multi-cultural areas, offering not only fresh produce, but widespread social and community benefits as well.

If crops fail, though, there is always the option of heading to the nearest supermarket. In Cribb's and others' view of the future this will be an option for only the lucky few as high prices force most people to rely on their wits and long forgotten ability to grow food – as has happened in Cuba, where repeated natural disasters and the collapse of the Soviet Union and its food supply pipeline forced the country to plant thousands of urban cooperative gardens to feed the population (see box: Caribbean Solution).

Urban jungle

The days of sweeping vistas filled with crops in various stages of maturity will be a thing of the past if innovative farmers have their way: they are taking a leaf from urban designers and looking up, not out.

Some of the proposed solutions include vertical gardens, which feature modular panels containing a soil-less growing media that supports a variety of plant types. The panels attach to vertical surfaces such as walls, fences and balconies, watered by a hydroponic system to ensure plants thrive. Although hard to conceive, it seems the day is not far off when cranes will be used to harvest pumpkins.

Green roofs are also part of the urb-ag mix – land-strapped Tokyo has a rapidly evolving rooftop agriculture growing fresh vegetables like sweet potatoes for local residents. Locally, the City of Sydney council is also looking into the feasibility of greening the roofs of the city's office towers and apartment buildings.

According to Tone Wheeler from Enviro Studio, one of the soon-to-be-published feasibility report's authors, while rooftop gardens can certainly provide foodcrops, they have other benefits as well, such as insulating the building below and improving its thermal performance, as well as social and educational benefits for city residents.

But it's not as simple as dumping a truckload of soil on a roof and scattering seeds. "There are some constraints to retrofitting greenroofs

on existing buildings, like the weight of adding plants, soil, water and other infrastructure,” he comments, saying they have recommended using lightweight, modified soil and planter beds that can be moved around by forklift or crane for maintenance purposes. Other issues, like high winds and intense sunshine, can be dealt with by planting vines on vertical structures and pergolas and growing windbreaks – just like any ground-based farm.

By far the greatest constraint is cost. “At the moment, green roofs make ecological, if not economic sense,” comments Wheeler. “If energy and materials were priced at their true ecological cost – something carbon trading is designed to do – then they would start to make much more economic sense.”

Limited space means much of the focus of city farming is on vegetable production, although there is research into the production of in vitro meat. However, one idea that has its origins with the Aztecs is suddenly being recognised as having a big role to play in city farming.

“The beauty of aquaponics, which combines fish keeping with the growing of vegetables, is that very small areas can be highly productive,” according to Geoff Wilson, president of the Urban Agriculture Network – Western Pacific. Similar to hydroponics, plants grow on rafts, however their roots dangle in water enriched by fish waste. The water is then filtered and recycled back to the fish tank.

“The only input is fish food, giving aquaponics the potential to be one of the major food production systems in the world.”

Australian-designed Ecocity Farm, an innovative aquaponics system that won the nightly award on ABC TV’s *The New Inventors*, is said by its inventors to produce more food per square metre than any other farming system currently in use. All solid wastes within the system are converted into nutrients (through a biofilter) and used to ‘nourish’ the vegetables. The system is also drought-proof as all water is continually recycled within the system, and the components are vertically stacked so the system has a production capacity up to five times that of existing systems of the same footprint, allowing it to be located in tight spaces and in urban areas where land is expensive. The vegetables also grow on a sushi-train style conveyor belt that ensures that, even in limited spaces, every plant gets enough sunlight to reach maximum productivity.

“Other aquaponics systems can be adapted for LED technology, which means large scale production can take place indoors, away from natural light,” says Wilson. One French

designer has taken that idea a step further – his ‘Local River’ replaces the TV with an equally decorative but functional refrigerator aquarium, where fish and greens cohabit in the units until being harvested – if you have the stomach for it.

High Rise Farming

While ideas like aquaponics, community and rooftop gardens and proliferation of cultivation towers, bags, pyramids, ladders, bottles, nets, fences, antennae, racks and even umbrellas, are all important, the reality is that, at present, they are too small scale. But specially-designed skyscraper farms that combine all of these ideas, and more, may provide the answer to feeding the masses.

Vertical farms were first mooted by Prof Dickson Despommier from Columbia University’s Department of Environmental Health Sciences. Intended to bring large-scale food production to the places where most of the consumption occurs, the concept calls for tailor-made skyscrapers containing multiple levels of viable farmland to provide year-round food production in a controlled, parasite-free environment.

Vertical farms will put an end to harvests being lost to storms, droughts or floods. Growing conditions will always be ideal, Despommier said recently in an interview with *Scientific American*. In addition, he says, the use of soil free cultivation methods may result in productivity up to 30 times greater than on traditional farms.

Indoor food production is certainly not new. Growers have been producing crops such as tomatoes and cucumbers in greenhouses for decades. But what makes vertical farming unique is its scale and use of multi-level design. Plans call for cutting edge energy systems such as biogas-fired cogeneration, geothermal heating

and cooling, rooftop photovoltaic (solar power) technology and water recycling.

Despommier also believes that not only would vertical farms not contribute to climate change, they should in fact help combat it: by producing everything the world’s highly urbanised population needs on the spot, GHGs associated with transporting food will actually be reduced. At the same time, he says forests can replace existing farmland helping to draw CO₂ out of the atmosphere.

To be viable, each farm must be able to feed 50,000 people, and will need to be at least 200 metres high (around 30 floors) to have a sufficiently large area for cultivation. To put that in context, some 150 vertical farms would be required to feed New York City’s current population, and as yet, they remain on the drawing board.

His idea has intrigued architects, but Despommier concedes that it would cost hundreds of millions to build a full-scale skyscraper farm. That’s the main drawback: construction and energy costs would probably make vertically-raised food more costly than traditional crops. At least for the moment. Investors have shown interest, and there is talk of building a prototype in the planned ecocity of Dongtan in China.

While Despommier’s vertical farming concept could revolutionise the way we produce food, there will be fallout from the move to urban agriculture, as workers accustomed to wide open spaces would need to move to cities and develop new skills. There are bound to be as-yet unthought of social and economic impacts caused by such a radical change, but the concept has the potential to ‘reboot’ our ecosystems and address issues as profound as global hunger. Agriculture is truly growing up. ★

CARIBBEAN SOLUTION

While much of the westernised world has been battling obesity epidemics, the Caribbean island of Cuba has stared down the threat of widespread starvation several times in recent decades: in the wake of the Soviet collapse in 1991 Cuba planted thousands of urban cooperative gardens to offset depleted rations of imported food. More recently, three hurricanes wiped out 30 per cent of the country’s farm crops, forcing the country to once again rely on its network of urban gardens to keep people fed.

Urban gardens have bloomed beside city parking lots, on rooftops, on vacant land and in the suburbs, and were the result of an old military plan for Cuba to be self-sufficient in case of war. They currently occupy 35,000 hectares of land across the country, and producing half of the leaf vegetables eaten on the island, which imports around 60 percent of its food, primarily from the US. The gardens sell their produce to the community and out of necessity grow their crops organically: when the Soviet Union fell apart, Cuba’s oil supply dwindled, hurting big state agricultural operations.

And despite an alliance with oil-rich Venezuela that will result in the construction of a fertiliser plant, new Cuban president Raul Castro is keen for the country’s decentralised approach to agriculture to continue, in a bid to lessen its dependence on imports and insure itself against future shortages.