

Vertical take-off



Imagine a skyscraper stacked high with floor after floor of food production. A futuristic vision home to everything from tumbling tomato vines to micro cress in neat rows, vertical farming could one day change the shape of horticulture in the UK and beyond. Anna Sbuttoni looks at growing fruit and vegetables from a different perspective

A “farmscraper” might sound like something out of science fiction, but the concept of vertical farming is being whispered about in fresh produce circles as a new take on commercial production and a means to help feed the forecast world population of nine billion by 2050.

Fast forward, and this method of farming could be a viable alternative for fresh produce growers, be it in five, 10 or 50 years’ time.

Farming upwards means growing hydroponically on multi-storey levels, in a way that is still being trialled and developed in a number of forward-thinking countries including the UK. This could be the answer to limited space, as well as finding a purpose for disused buildings in urban areas, cutting food miles by bringing production closer to population centres and raising productivity and energy efficiency to unprecedented levels. The possibilities are many, with all the advantages of indoor production, energy and water recycling, waste management and the potential to have the length of the supply chain under one roof.

Is this what the Hanging Gardens of Babylon would have looked like if they had the technical knowhow we have today?

A pioneer of the concept, Dr Dickson Despommier, set out a sweeping vision last year in his book, *The Vertical Farm*. He presents it as agriculture for the 21st century, an answer to feeding the world in the future and crucially, a venture that is within reach. “These farms would raise food without soil in specially constructed buildings,” he writes. “When farms are successfully moved to cities, we can convert significant amounts of farmland back into whatever ecosystem was there originally, simply by leaving it alone.

“This plan may sound naïve and impractical. Yet the concept of vertical farming is dead simple. Still, making it happen could require the kind of expertise needed for, say, rocket science or brain surgery. Then again, human beings do rocket science and brain surgery quite well. We should not shy away from the challenge of farming vertically simply because it requires cutting edge engineering, architecture and agronomy. All of this is





within our grasp.”

In the foreword to the book, Marjora Carter, who founded Sustainable South Bronx in 2001, claims that “if the skyscraper farm is like a 747 jetliner, we are now at the stage of the Wright brothers”.

“All kinds of micro-agribusinesses are bursting onto the scene in cities across America and in other countries around the world,” she writes. “There will be as many failures as a legion of tinkers and engineers all struggle to take off with the right combination of profitability, sustainability and quality food.”

But on the ground, there have already been moves to examine vertical farming in a practical, workable way in the UK and overseas.

Paignton Zoo Environmental Park is not the first place you might think of for horticultural innovation, but it has been home to a pilot project for vertical farming since September 2009. The venture, with Valcent Products (EU) Ltd, aims to show how food can be produced to offset food bills, increase food security and facilitate research and development.

The system is made of three metre high, multi-level growing trays suspended from an overhead rack. Each rig consists of eight levels of trays, of which there are two different sizes to accommodate different crops grown simultaneously. Advanced hydroponic technology makes it possible for 70 custom-made rigs holding 16 growing trays suspended on a closed loop conveyor to grow 11,200 plants. They are continuously moved around on a conveyor, to optimise light and air. Using this system, the 120sqm greenhouse grows three times the 3,000 plants that

would be expected in a conventional hydroponic system.

A computerised environmental control system provides the best growing environment, while run-off water and nutrients are captured and recycled. At the same time, the vertical structure reduces the land needed to grow the same number of plants, reducing the investment that would normally be required for a project of this kind.

The project ran for just over a year before it was interrupted for some adjustments including the addition of LED lights and modifying the irrigation system, but will reopen in late February or early March.

Kevin Frediani, curator of plants and garden at Paignton Zoo Environmental Park, saw the opportunity to link up with Valcent Products and took it, with the aim of growing food for the animals, improving their diets and experimenting with crops outside the normal buying power on limited land.

He now has a scholarship at the School for Social Entrepreneurs, where he will work on how best to raise the profile of vertical farming and how to educate both future growers and policy makers so that they can make informed decisions.

“A commercial producer would not have grown the range of crops that we have grown and they would add background heat and light,” says Frediani. “For us, it has very much been a pilot and to make the most of the cost benefit, you would have to go up the next scale. But for those who are interested in investing in this technology and taking production closer to population centres, there is a great opportunity.

**Vertical farm pilot
at Paignton Zoo
Environmental Park**

“A great analogy is the development of the motor car,” he continues. “Very early on, when you bought a car it was expensive but very slow and you had to stay behind a man with a red flag. At the time, it might not have seemed as good as buying a horse.

“In the UK, there’s a huge amount of land that is not being used effectively for production. To make the investment in vertical farms requires you to have alternatives that are not economically viable but in the UK at least, there are still other ways we can improve on production.

“However, if you look elsewhere in the world such as the Middle East or some parts of the US where there are arid areas, it is a no brainer.”

The pilot is the first full-scale study of the VertiCrop system and comes ahead of six major projects worldwide in the design stage, ranging from commercial operations to special projects with urban authorities looking to utilise disused industrial space.

Chris Bradford, managing director of Valcent Products, insists that the Paignton-based trials are a sign of things to come. “We have been able to get a lot of data on plant growth rates, nutrition and operating procedures but most importantly, we have confirmed that it works,” he says. “We have been able to identify a range of crops that are most suited to being grown this way, including leafy greens, salads and culinary herbs.

“The main advantage of growing in an enclosed environment where you can control growing conditions is that you can feed the plants with the exact amount of nutrients they need, control air flow and temperature – everything you need to get maximum production. We can grow up to 20 times what you can grow in a comparable space in outdoor, single layer of production.

“And because we are growing increased volumes, the energy efficiency is sufficiently better than in conventional growing.”

This is all very well, but how much does it cost to get started? A standard model based on 212sqm with an optimum height of four to six metres will cost approximately £300,000 for the basic system, without a building or ground preparation.

“If you have a disused barn or a warehouse or if you are looking to expand but can’t get the land, we can put one of our systems in,” says Bradford. “There are a lot of academic institutes that are looking at





what we are doing.

“The idea of vertical farming in urban areas may well be attainable some way down the road but we have a fair way to go yet before we start raising pigs and milking cows in high-rise buildings.

“We have approached this from a practical aspect. It doesn’t require a 30-storey building, it can be done in a warehouse or industrial estate. Our system ticks most of the boxes for the urban farming idea.”

But beyond this pilot, there is an opportunity to look at urban crop production on a commercial scale. Theoretically, it could be used by existing growers to maximise efficiency and volumes. Some of the most innovative

UK growers have considered vertical farming as an option. As yet, commercial success has been limited but growers working with different lines across the UK are continuing to look at how the concept can be made to work better in future.

Dave Griffiths, technical director at forward-thinking firm Angus Soft Fruits, first saw the system in Israel in the mid-1990s as a means of achieving high-density plantings even with a shortage of glasshouse space. He subsequently tried it in the UK with strawberries on a small scale, to look at the correlation of plant density and cost to yield and return.

“My findings were that the increased density of plants went past the economic optimum and additional cost of plants and structures was not recoverable,” he says. “Yield per square metre did not increase proportionate to plant density as

VERTICAL FARMING – AN UPHILL STRUGGLE?

Ben Reynolds, network director at food and farming alliance Sustain, on whether vertical farming really will have a future

Urban agriculture is a hot topic, in particular the notion of vertical farming. Whether it’s a wall of salads or a skyscraper full of livestock, the defining features are not so much the urban environment, but the technological aspects of the systems being explored. There’s something very appealing to the human psyche about fixing problems with technology, the thrill of invention and taking a step forward for humanity. But let’s start by asking why we need this?

Firstly, the argument is made that this will help reduce the environmental impact of food production. Whether you take this as energy use, carbon emissions or chemical inputs, it would make more sense to buy from an organic farm, or any type of conventional farm come to that. The amount of energy needed to make and run the equipment needed, notwithstanding developing the building itself – be it a new build or retrofit – will outweigh the energy needed to produce food ‘horizontally’.

Vertical farming is claimed to reduce food miles, but it is the production of food rather than the transport that has the biggest impact on greenhouse emissions, which makes this claim irrelevant. In any case, the problem of food miles is partly about the absurdity of transporting food halfway around the world when it’s on your doorstep. If at the mercy of market forces, like most farming, who’s to say that this produce won’t be transported away from the city it was intended to feed?

The next reason used for vertical farming is that we are short of space to grow enough food. This may have more value in some other countries, however in the UK rather than converting disused urban land to grow food, it

would be a good start – and a whole lot cheaper – to stop building on farmland.

Linked to space, is of course, the amount of food that is being produced. The world faces more food riots as its population increases. I think a lot of farmers would question why they have to plough crops back into the land if it was simply the case that more food is needed. But sadly, dealing with food waste is not easy in the current food system – rather, it is easier to invest in the technology to produce more.

But who is going to invest in this technology and where? Will it be in the parts of the world where more food is really needed? This is unlikely when you consider the amount of money needed to create the edible high rises that are being suggested.

And it all comes down to money. The reality is that people like gimmicks, they like technology. Someone out there with more money than sense is going to invest in this. People don’t always do things that make sense. So in this respect, there will definitely be a place for vertical farming in our mixed up world.

The main problem with vertical farming is that we don’t need it. It is not the best solution to our current problems with the food system, be they environmental problems or a lack of supply. It’s not even part of the solution at the moment. Over the coming years, we will see vertical farms, but they are most likely to be run as educational demonstrations or community projects until food prices start to go up incredibly. And in this scenario, it’s hard to predict what market there will be for salads when more and more people start going hungry. ■

The main advantage of growing in an enclosed environment where you can control growing conditions is that you can feed the plants with the exact amount of nutrients they need, control air flow and temperature

light became the limiting factor to yield and fruit quality.

“Picking costs were also high as in the vertical tower system we were testing, effective leaf management of the crop was virtually impossible.”

However, Griffiths insists that there could be a future for vertical farming “in an environment where heating costs were generating a very high value crop and some of the practicalities we experienced could be overcome”.

But he admits that as soft-fruit availability is more or less year round from various reliable sources, “it is difficult to imagine” it taking off.

Farming vertically on a commercial basis remains a concept, but it is one that is turning heads as the fresh produce industry looks at its long-term position. Whether the idea can really work in practice or not, it is encouraging growers to rethink conventional production methods and challenge what they can achieve in an increasingly competitive market. ■