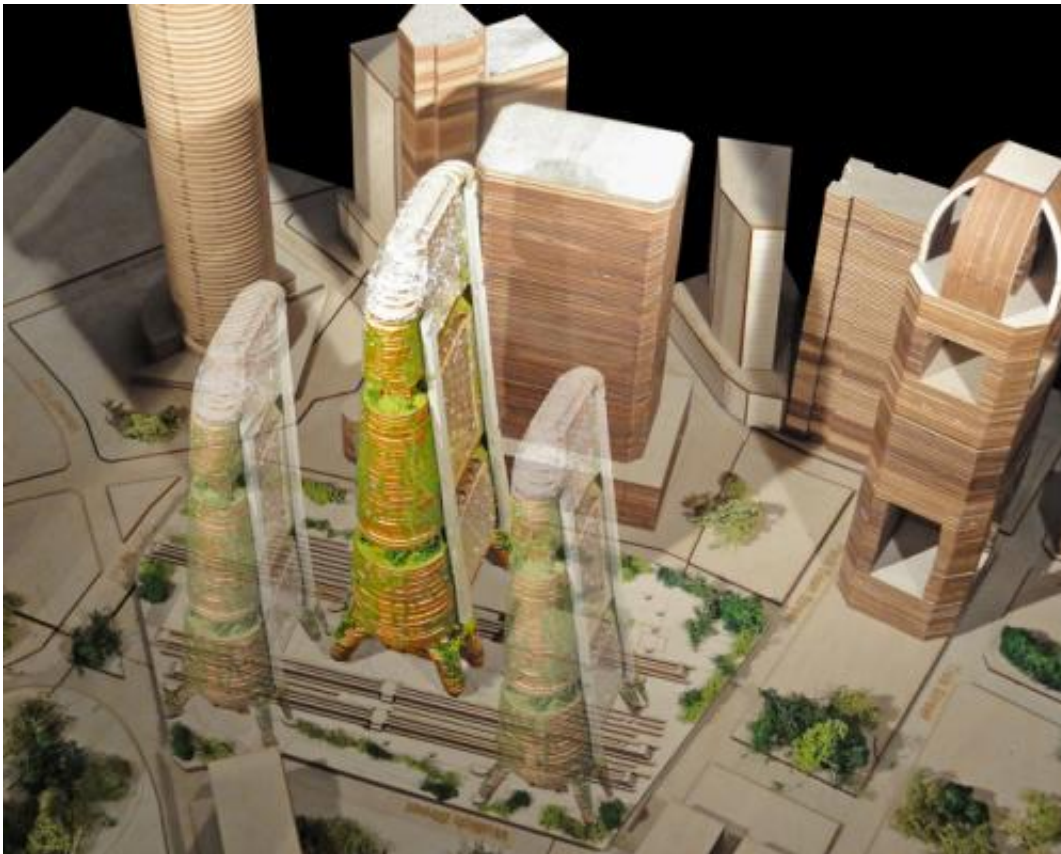


# Vertical farms offer a bright future for hungry cities

July 21 2014, by Tim Heath

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Vertical farms: coming to a street near you? Credit: Matthew Humphreys, University of Nottingham

The 21st century has seen rapid urbanisation and the global population is now expected to grow to more than 8.3 billion by 2050. Currently, 800m hectares – 38% of the earth's land surface – is farmed and we'll soon

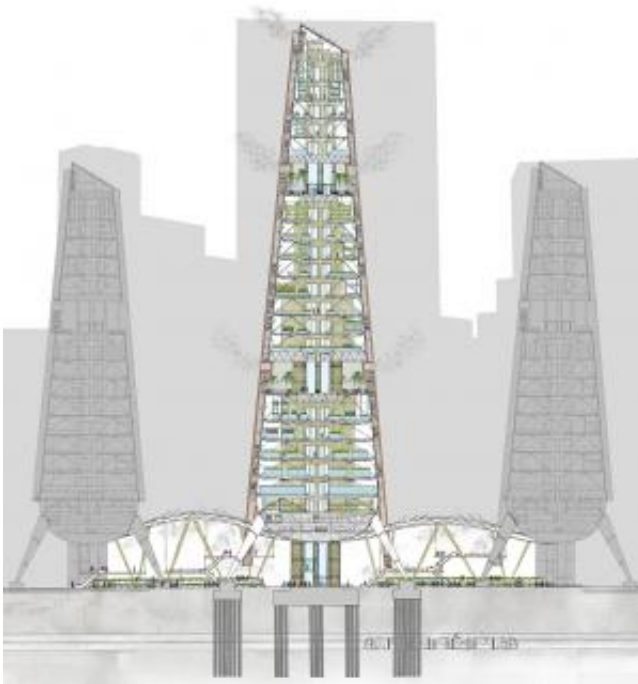
need to give over another 100m hectares if we continue to use current agricultural methods. That's not additional fertile land that actually exists though, so some are investigating the potential of vertical farming.

It has been [suggested](#) that a 30 storey 27,800,000 m<sup>2</sup> vertical [farm](#) could be achieved within one New York City block. That farm could feed 50,000 people, providing 2,000 calories for every person each day. With results like that as a prospect, it's easy to see why enthusiasts see vertical farms as the future.

## Growing up

Vertical farms are still very much at the conceptual stage. The idea is to cultivate crops on multiple levels within high-rise buildings in urban areas. It's not an entirely new proposition, with architect Ken Yeang suggesting a vision of high-rise plant cultivation in mixed-use skyscrapers as early as the 1980s. Professor Dickson Despommier, the leading international advocate of vertical farms, describes them as "[a global solution](#)" to the world's urban food needs.

Vertical farms do indeed have many advantages. They would enable us to produce crops all year round using 70% less water. We wouldn't need to use agro-chemicals and could avoid the adverse environmental factors that affect yield and quality in more traditional farming. And if food were grown in urban areas in the first place, we could eliminate the financial and environmental costs of importing food into towns and cities.



Section through a proposed vertical farm. Credit: Matthew Humphreys, University of Nottingham

## Growing pains

In some respects, farming is now a practical possibility. The technology it requires, in terms of plant growth and construction, are available. We can already cultivate plants without soil and recycle the water used to deliver clean indoor farming, for example. Hydroponics, where plant roots are grown in nutrients dissolved in water, is one option. This plant-growing technique can be combined with traditional aquaculture to raise fish or prawns – a farming technique known as aquaponics. Another way to grow plants is aeroponics, which involves growing suspended plants by spraying the roots with a nutrient-rich water solution.

But even though it has been more than 20 years since the concept

was first proposed and the pressure of climate change continues to mount, vertical farming is still not a reality. The two biggest problems have been [financial and technological viability](#), particularly when it comes to actually building these high-rise spaces.

Vertical farms need contemporary building materials and renewable energy systems. Sunlight reflecting and collecting devices such as light shelves, light pipes and fibre optics can deliver natural light deep into buildings to provide energy for photosynthesis.

The development of LED makes it possible for a vertical farm to operate without the need for sunlight but the cost and energy consumption are currently prohibitive. The initial cost could easily be more than \$100m for a 60-hectare vertical farm, which makes it unrealistic at the moment. But this could change as the price should [drop rapidly](#) as the technology develops. The obvious solution is to integrate natural light where conditions are suitable and LED in other parts of the building.



Inside a proposed vertical farm. Credit: University of Nottingham

In the meantime, investors are likely to stay away. Vertical farms integrate advanced technologies and need to be relatively large-scale if they are to yield attractive results. It has been [estimated](#) that the return on investment for a 10-storey vertical farm would be approximately 8%, whereas investors typically seek a minimum rate of return of 10-12%. And since there are risks involved in developing a new type of building, investors are realistically more likely to want an annual return of around 15%. Again though, economic viability will undoubtedly come with technological improvements.

## **Making it happen**

Progress is being made towards resolving all these issues so the next step will really be to get a prototype [vertical farm](#) up and running in an urban location. What few small-scale prototypes exist in the world are based mainly in research institutions. To be sure that the technique can work, we'll need to construct a high-rise structure in a more realistic environment. If it works, it could spark follow up projects.

To make vertical farming a reality, we need the support of governments and pioneering organisations willing to take a punt. If they do, we could make a huge contribution to food security and could transform the everyday lives of city dwellers across the world. There are more than 26 cities with a population of over 10m, each requiring up to 7,000 tons of food to be imported to feed their residents — vertical farms could, be one of a package of more sustainable alternatives to feeding them.

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