

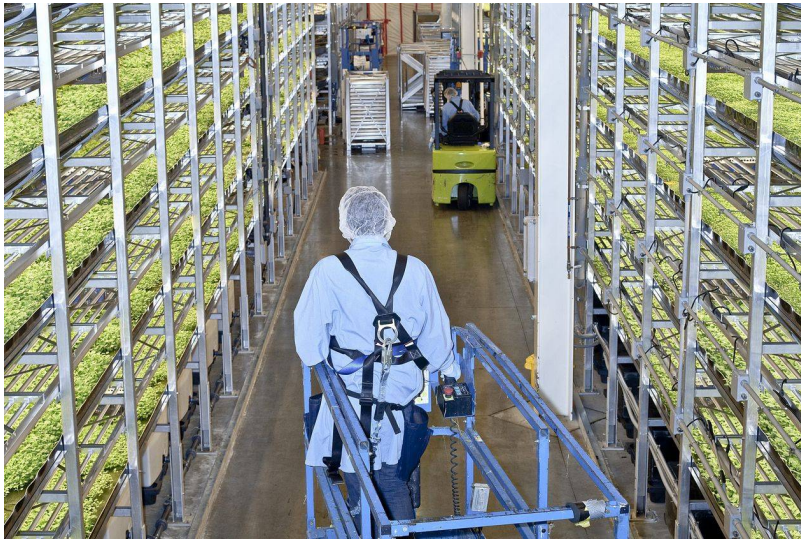
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ESSAY

Vertical Farms Fill a Tall Order

Indoor crops grown by high-tech methods are on the rise as the Covid-19 pandemic spurs interest in food security for cities.



Stacked trays of greens growing at the Newark, N.J., facility of AeroFarms.

PHOTO: BRYAN ANSELM FOR THE WALL STREET

By Dickson Despommier

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The Covid-19 pandemic has disrupted agricultural production and supply chains around the world. Farmers have often struggled to get their food to distant markets, and sharp shifts in demand have repeatedly forced them to dump crops. Avoiding such logistical problems is one of the chief advantages of vertical farms, a new approach to agriculture that aims to grow food closer to population centers.

Over the past 10 years, hundreds of such indoor farms have sprouted up around the globe, mostly in the larger cities of industrialized countries. They occupy multistory buildings in which crops are grown in water or in misted air instead of soil, with LED lights in place of sunlight, in a controlled and largely automated environment.

Building more vertical farms in cities is especially timely because of the expected effects of the pandemic on urban office towers. Moody's Analytics REIS now projects office vacancies to rise to 19.3% in the 82 largest metropolitan areas by the end of the year, up from 16.8% last year, and then to continue rising. In June, 82% of employers surveyed by market-research firm Gartner, Inc. said that they would allow employees to work from home permanently. Indoor farms can occupy some of the abandoned or underused office space created by these trends.

So far, vertical farms have mostly grown and sold leafy greens and herbs—the easiest food crops to grow indoors and to harvest year-round. They are competitive against conventional farms because their crops don't have to travel far and are free of pesticides and other soil contaminants.

Strictly controlled conditions enable vertical farms to bypass the unpredictable variations of weather and soil.

As demand rises, however, vertical farms are poised to add a number of other crops that can be grown effectively indoors. These include root vegetables (potatoes, radishes, carrots, celery), vine vegetables (green beans, tomatoes, peppers), and bush fruits (blueberries, blackberries, raspberries). Such an expansion could eventually result in a significant shift of agriculture to cities, where 60% of the world's population now lives.

Vertical farms are no longer some futuristic fantasy. Well-established, efficient hydroponic and aeroponic methods have been paired with newer technology such as high-performance LED grow lights. Artificial intelligence now often controls the instruments that automatically deliver nutrients and provide optimal lighting for each crop.

The strictly controlled conditions inside vertical farms enable them to bypass the unpredictable variations of weather and soil and to exclude the heavy metals and other elements so common in traditional agriculture. Such control also allows endless experimentation to develop the best-tasting produce and most efficient ways of growing.

And when pollination is required, bumblebees do the job quite nicely, just as they do outdoors.

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Creating and maintaining that environment takes big startup costs for technology and ongoing costs for energy. But the efficiency of such farms allows nearly 95% of indoor seedlings to be grown to maturity and harvested, according to Gene Giacomelli, professor of biosystems engineering at the University of Arizona. By contrast, the survival rate for outdoor crops, from planting to harvest, vary from 90% in good years to 70% or less in drought or flood years. The latter have been increasing because of climate change, with record-high temperatures often accompanied by extreme weather patterns.

On multiple floors of a single building, layers of vertical fields can be harvested in phases to provide year-round crops. Since the farms are close to their target consumers, spoilage and damage from shipping are greatly reduced. Eventually, such farms could provide healthier produce options in under-served neighborhoods that have been described as “food deserts.”

One of the largest and earliest commercial outfits, AeroFarms of Newark, N.J., was started by an agronomist in a defunct paintball arena in 2004. After several false starts, it flourished in 2014 with the help of \$200 million in startup funding from the city and private firms. AeroFarms relocated to 70,000 square feet in Newark's Ironbound district and won contracts with local restaurants, supermarkets and school lunch programs. It has since added larger facilities of 150,000 square feet in Danville, Va., and 90,000 in Abu Dhabi. The company supplements its 72 staff with local personnel trained to work in various phases of crop production.



An employee of Berlin-based Infarm checks an indoor growing system at the company's headquarters showroom.

PHOTO: HANNIBAL HANSCHKE/REUTERS

Infarm, founded in Israel in 2013 and now based in Berlin, operates differently, exporting its model directly to supermarkets. (I serve, without pay, on its science advisory board and as a paid advisory board member for another firm.) It provides in-store, automated hydroponic growing systems. Each store selects its own mix of greens and herbs, and consumers are encouraged to choose, taste and harvest from a menu growing right in front of them. The original startup employed a retrofitted 1955 Airstream trailer as its mobile crop production vehicle. Now it employs more than 400 people in 40 countries, mostly in Europe. It sells through, among others, Kroger grocery stores on the West Coast and Marks and Spencer in London.

There are many other vertical-farm startups backed by venture capital and expanding in Europe and the U.S., as well as on the Arabian peninsula, where they can provide an alternative to hot, arid conditions. But other firms have failed, or have canceled expansion plans, as they struggle to manage their costs and compete in local markets. And vertical farms aren't likely to gain a competitive advantage over conventional farming when it comes to important commodities such as fruits grown in orchards or grains grown in vast fields. Both are possible to raise in vertical indoor settings, but so far, their yields are too low and seasonal to be economical.

SHARE YOUR THOUGHTS

Would more food crops grown indoors in cities be a helpful trend in agriculture, or not? Join the conversation below.

The pandemic has sparked new demand for the industry. San Francisco-based vertical farm Plenty says that a significant increase in shipments has sped up its effort to diversify crops. The company has already experimented with strategies to add items such as tomatoes and strawberries.

Covid-19 has been a harbinger of longer-term problems in food security for our cities. One answer may come from growing more of our food just down the street.

—Dr. Despommier is emeritus professor of public health and microbiology at Columbia University and the author of “The Vertical Farm: Feeding the World in the 21st Century.”

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