



# Grown Ups

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**If you want to see the future of agriculture, look up.**

BY COURTNEY BALESTIER

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## What's the Idea?

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Feeding the global population currently requires farmland roughly totaling the land area of South America, and by 2050, we're going to need another plot the size of Brazil to feed us all. So says Dr. Dickson Despommier, author of *The Vertical Farm*, who also points out that modern farming isn't exactly rigged for expansion. Growers exhaust land, chemicals leach into the soil, and elaborate irrigation methods are sometimes necessary to make land arable. Dr. Despommier, a professor emeritus of public health and microbiology at Columbia University, espouses a different solution: farming up, not out.

Vertical farming takes agriculture indoors, with different crops grown on different floors of a multistory building or in stacked growing systems on a single floor, all in controlled environments. Plants can be grown using methods like hydroponics (plants grown in water), aquaponics (plants grown in a symbiotic environment with aquatic animals, wherein the fish fertilize the plants), and aeroponics (plants grown in an air-and-mist environment without soil). Light comes from grow lights; nutrients like nitrogen, phosphorus, and potassium can be added directly to the water. Dr. Despommier predicts that, in the next twenty to forty years, every major city will derive as much as 20 percent of its vegetables, fruits, and herbs from vertical farms.

### What do we stand to gain?

The variables that can sabotage traditional outdoor agriculture—droughts, floods, plant disease—will become regulated, controlled quantities in a vertical farm. Vertical farms employ sanitary measures like air locks and air showers, so there's also no need for pesticides. (Pollination can be achieved manually; Green Spirit Farms, a Michigan-based vertical farm, uses electric toothbrushes.) And since there's also no soil, that means no runoff-caused pollution.

Abused farmland would be rehabilitated, since the basic premise of vertical farming is that you don't need land at all. Vertical farms

often pop up in retrofitted existing architecture, too, so any number of old Walmarts or abandoned shopping malls could be reborn as viable food sources. Ecosystems that couldn't otherwise support a healthy diet's worth of traditional agriculture—places like the United Arab Emirates, Greenland, or dense urban environments—could produce their own food, or at least some of it, thus reducing the need for transporting produce over long distances. What's more, they could produce year-round: Green Spirit Farms sells a gourmet lettuce mix that grows on a twenty-one-day cycle, generating seventeen harvests per year.

Vertical farming also uses about 98 percent less water than traditional farming, because water can be recycled back into the system. An acre of lettuce farmed outdoors in California might need anywhere from 270,000 to 972,000 gallons of water, depending on the operation; Green Spirit Farms president Milan Kluko says he can produce an acre of romaine with 5,400 gallons.

### But what are the costs?

Vertical farming is a costly proposition. Existing buildings need to be retrofitted with air locks and air showers, vertical growing systems, and self-contained growth platforms that can go for about \$100,000 a pop. It remains to be seen whether vertical farming makes economic sense on a wide scale.

Then there's the energy usage: all those grow

lights add up. Even though companies like Philips (which even has a director of city farming) are making LED grow lights that are 75 percent more efficient than existing fluorescents, converting electricity to light remains far less efficient than using sunlight, so the environmental upside of vertical farms relies largely on clean-energy technology with the ability to redirect or minimize carbon emissions.

AeroFarms—a farm in Newark, New Jersey—has a massive, in-progress headquarters backed by \$39 million from the likes of Prudential Financial and Goldman Sachs. It will rely on a quad-generation system that merges electricity production, heating, and cooling, and directs the carbon dioxide it generates to encourage plant growth. “This is not easy stuff to do,” says chief marketing officer and co-founder Marc Oshima. “You have to have an expertise in not only horticulture and growing; you need to have an expertise in mechanical, electrical, structural, and process-control engineering. You need to be a statistician, electrical engineer, lighting engineer. We talk about food safety, marketing, product development, understanding sales, and sales channels. Those are a lot of different hats for an organization to wear.”

### The outlook

The most optimistic visions of vertical farms imagine skyscrapers of produce with

sleek Apple Store aesthetics. “Forget about all that,” Dr. Despommier says. Even the term “vertical farming” might be a bit oblique: the real-life incarnations have tended to be repurposed one- or two-story buildings. In Chicago, John Edel is turning a 93,500-square-foot former meatpacking plant into a hub of vertical farms and food businesses in a closed-loop, net-zero-energy system called The Plant. In Japan—a country that Dr. Despommier says has been forced to the forefront of vertical-farming technology by the Fukushima disaster and its impact on arable land—the headquarters of human-resources company Pasona Inc. has an indoor farm, complete with a rice paddy, and serves house-grown produce in the office cafeteria. Toshiba and Fujitsu are converting shuttered manufacturing centers into farms. Panasonic is doing the same in Singapore.

Many vertical (or indoor) farms are operational, and how these early adopters respond to issues like energy efficiency and crop density—as well as how, or if, large-scale investment follows—will give us some idea of whether this a viable, scalable solution. That AeroFarms can present a business model so attractive to the venture-capital crowd is a good sign for other outfits trying vertical-farming solutions. As clean-energy solutions improve and interest grows, the possibilities for vertical farming could, too.