

# GROWING TO NEW HEIGHTS



## While vertical farming offers opportunities for producers to fill niche markets, researchers are still working out some of the kinks.

by LAUREN ARVA

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When we think about food production, the idea of vertically producing crops likely does not jump to mind.

However, some producers do farm in such settings. They use facilities like abandoned warehouses and storage containers to grow produce. They fully manage their crops' growing conditions with temperature, moisture and artificial lighting controls.

Although farming inside containers and vertical farming are still in their infancy, Tyler Whale, president of Ontario Agri-Food Technologies (OAF), believes the potential benefits of these production methods outweigh their drawbacks. OAF is a non-profit organization that assists Ontario agri-food and agri-tech businesses and entrepreneurs by providing access to networks, funding programs and industry expertise.

Whale has high hopes for the future of this sector. "I think it's going to be on a massive rise," he tells *Better Farming*.

### Recognizing the advantages

A key advantage that vertical farming has over conventional field production is the input-to-output ratio, Whale says.

"You use far fewer inputs like water, pesticides and herbicides," he says. "In some cases, you can use almost zero herbicides and pesticides."

And indoor farming methods usually require less – or even no – soil.

"Whether it's hydroponic or aeroponic, indoor farming can be in a soil-free environment," Whale explains.

In a hydroponic operation, plants grow in liquid, sand or gravel. In an aeroponic operation, plant roots hang in the air where they receive nutrients from a fine mist.

Dr. Youbin Zheng, an associate professor in the University of Guelph's school of environmental sciences, provides further insight into the amount of inputs required for indoor farming.

"Research shows the hydroponic production of lettuce uses 12 times less water" than conventional field production, Zheng tells *Better Farming*.

Technological advances support this decreased use of resources, says Bianca Jamieson, an OMAFRA media relations strategist.

Precision water and fertilizer use enables producers to optimize inputs to match the specific plant's requirements while reducing waste, she tells *Better Farming*.

Typically, the enclosed and climate-controlled indoor farming environment helps to protect crops from pests and diseases, Jamieson says.

Because outside conditions do not affect production, indoor farming operators have flexibility in selecting their geographic locations.

Since "indoor production does not need fertile soil," these types of opera-

tions “can be set up anywhere,” Zheng says. They are “especially good for fresh produce to be grown and consumed locally.”

Another significant advantage of vertical farming operations is increased productivity.

“You can get more density per square unit of area, and therefore more productivity, when you go vertical and not just horizontal,” Whale says.

Vertical indoor farming allows for “multilevel productions,” Zheng adds.

“If you have one acre of land, and if you have 15 levels of production, then you’ve extended your production area to 15 acres,” he explains.

“You can also control the environment and avoid the limitations of bad weather. You can grow produce year-round, and each crop cycle can be much shorter than in the field.”

Vertical farming is “very high-intensity farming. The turnover is very rapid, by and large, for these crops,” says Dr. Michael Brownbridge, research director of horticultural production systems at the Vineland Research and Innovation Centre. The speed at which the crops grow helps to limit the window for disease and insect pressures, he adds.



Dr. Youbin Zheng

The increased yields of indoor farms are an additional advantage.

Jamieson gives the example of lettuce production. “Yield is a minimum of 15 to 20 times higher in greenhouse farming” than in conventional farming, she says.

The move to lettuce production in vertical farms brings a tenfold increase in yields over greenhouse production.

### Navigating the challenges

While indoor farming protects crops from inclement weather, the systems also inhibit plants from receiving natural sunlight. So, producers must use lighting technology.



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The move to indoor farming could help producers of basil, Boston lettuce and romaine lettuce overcome production challenges, says Tyler Whale.

Per acre, vertical farming typically involves higher capital costs than outdoor farming, Brownbridge says.

“Relatively speaking, indoor farming is an expensive system to set up, and it uses artificial sunlight provided by way of some sort of grow lights, particularly LED lights, these days,” he says.

Indoor farming uses a significant amount of energy for this lighting as well as temperature and humidity control, Zheng adds.

“But, of course, if you apply energy-harnessing technology like solar to the system, then you mitigate that,” says Whale.

Vertical farming is also labour intensive, although robotic options are available for some of this work, Whale says.

Finally, while the tightly packed enclosures are generally effective at keeping pests and diseases at bay, these production challenges can be difficult to overcome if they do reach the indoor crop, Brownbridge says.

### Finding locations

Vertical farmers have more options for production locations than field producers, who face increasing pressure from urban sprawl.

Since vertical farms can be located near “big population areas,” these facilities become “hyper-local opportunities,” Whale says.

“Canada imports, I think, around \$3.5-billion worth of leafy greens, largely from irrigated land where

water scarcity is an issue in the U.S. That doesn’t make environmental sense, especially when indoor production can come at near parity, in terms of costs, with what’s being imported,” he adds.

Zheng agrees, emphasizing the positive effects that vertical farming can have on the labour market.

“If you build an indoor production facility close to a big city, you can provide good employment opportunities for people,” he says.

Despite these benefits, individuals who establish indoor farms in highly populated areas can face resistance, Whale says.

“If your region, whatever governance you’re beholden to, can’t get its head around the regulation of urban or indoor farming,” starting a farm can be difficult, he says.

“Let’s take the sea or shipping container model or the small container model. Why is using one different than putting in a temporary construction site container, in terms of regulations? You need a little bit of water, a little bit of power and a drain that you can flush some waste down.

“You will have to comply with the standards of putting waste down the drain,” he says.

“So, I think a lot of urban regulations worry about competing with farmers. But, frankly, if you’re growing (a product that is often imported), you’re not competing with local farmers. You’re displacing imports.”

**Looking ahead**

The possibilities for vertical farming are promising.

The sector's potential for expansion is tied to its location flexibility, says Whale.

"Producing food in hard-to-grow places – whether we say the north, a desert, a mine or even a 'food desert' in an urban location" – is possible with indoor farming, he says.

The hyper-locality of this farming method is something to watch, Whale adds.

"We always talk about increasing our exports, but I think we have to think about the elimination of an import. Indoor farming will contribute more in the high-end, highly perishable" sectors.

Producers of crops such as "mint,



**Dr. Brownbridge**

basil, Boston lettuce and romaine lettuce" must manage difficult growing conditions. These crops are threatened by the possibility of bacterial contamination, for example, or involve high costs for pesticides, herbicides, irrigation and transportation. The move to indoor production could help growers overcome these challenges, Whale says.

Brownbridge, though, stresses that vertical farming will not supplant field- or greenhouse-based fruit and vegetable production. The systems serve different markets.

"I could see indoor farms having a place to supply a very local market. You could set these systems up very close to an area you want to supply," he says.

"There is a niche for it, but ... it's not a system I see feeding the world or creating large quantities of relatively affordable food for a lot of people," Brownbridge adds.

As for research initiatives in this sector?

"With present technology, green,

leafy produce performs extremely well in indoor farming, while taller-growing fruited vegetables, such as tomatoes, cucumbers and peppers, are more challenging," Jamieson says.

"Research is looking at breeding specifically for this type of production system in the hopes of making it more economical in the future," she says. "Learning more about the light spectrum on plant physiology, for example, could improve production efficiencies." **BF**

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