



# Alternative Farming – A Need for the Future

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Traditional farming has been essential to supplying food for generations of human history. However, alternative farming methods have emerged as the world's population grows and technology advances. Alternative farming is a systematic approach to farming intended to reduce agricultural pollution, enhance sustainability and improve efficiency and profitability. Alternative farming has become an emerging industry and an opportunity for the future due to the increase in food demand and loss of total farmland. It is projected that there will be ten billion people on Earth by 2050 and agriculture production levels will need to increase by 60-70% of current-day production to satisfy the growing population.<sup>1</sup> Meanwhile, current real estate trends are consuming U.S. farmland at a high rate. In California, developments are consuming an average of 40,000 acres of agricultural land per year. If current development trends continue, 1.3 million acres of California agricultural land will be developed by 2050.<sup>2</sup> Reduction in total farmland has been occurring since 1949 and technological advancements in farm equipment, fertilizer and irrigation have allowed for greater productivity per acre of farmland.<sup>3</sup> Alternative farming has the capability to continue the technological advancement to make farmland more productive.

Two key methods of alternative farming are vertical farms and greenhouses. These two methods have the potential to provide a solution to the future demand for food production and interesting investment opportunities. Vertical farms and greenhouses are able to provide a significantly higher annual yield per square foot, while consuming less water and incorporating more sustainable farming methods than traditional farming.

## **Vertical Farming:**

Vertical farming is an evolving alternative farming method that is focused on the use of space and resources in an efficient manner. A vertical farm involves growing crops within a stacked tower or shelved structure in a closed building or container. Crops are planted in stacked formation or pods that allow for a controlled environment and scalability. Vertical farming has grown in popularity within large urban areas that lack the proximity to fresh produce. These large urban areas also provide many opportunities for future vertical farms to take operation. Popular types of buildings for vertical farms include older, functionally obsolete industrial buildings as well as the use of abandoned

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<sup>1</sup> Silva, George. "Feeding the World in 2050 and beyond – Part 1: Productivity Challenges." MSU Extension: Agriculture, July 29, 2021. <http://www.canr.msu.edu/news/feeding-the-world-in-2050-and-beyond-part-1>.

<sup>2</sup> Thompson, Edward. Agricultural Land Loss and Conservation. July 2009, [www.cdfa.ca.gov/agvision/docs/Agricultural\\_Loss\\_and\\_Conservation.pdf](http://www.cdfa.ca.gov/agvision/docs/Agricultural_Loss_and_Conservation.pdf).

<sup>3</sup> Nickerson, Cynthia, and Allison Borchers. "How Is Land in the United States Used? A Focus on Agricultural Land." USDA ERS - Data Feature: How Is Land Used, 1 Mar. 2012, [www.ers.usda.gov/amber-waves/2012/march/data-feature-how-is-land-used/](http://www.ers.usda.gov/amber-waves/2012/march/data-feature-how-is-land-used/).

shipping containers. There are three distinct systems that are used in vertical farming - hydroponic, aquaponic and aeroponic systems.

### *Hydroponic*

Hydroponic systems are the most widely used method in vertical farming today. These systems place the crops in containers that are designed for the roots to be submerged in a nutrient filled solution. This allows for a precise growing environment that lets the farmer control the exact nutrient balance being delivered to the crops.



*Hydroponic Farm (Source: Medium.com)*

### *Aquaponic*

Aquaponic systems combine aquaculture and hydroponic designs. Aquatic organisms such as fish, crayfish or prawns are kept in a closed system that allows for the crops to feed off of the natural nutrients from the organisms. These systems produce slower growing crops and therefore are not as widely used.



*Aquaponic Farm (Source: Agfundernews.com)*

### *Aeroponic*

The last method of vertical farming are aeroponic systems, which were designed by NASA to grow crops for astronauts in space. Aeroponic farms place crops in a vertical tower system and deliver nutrients through the forced circulation of mist. Aeroponic farms have not been widely used but are being adopted more frequently as the technology becomes more accessible.



*Aeroponic Farm (Source: Agratech.com)*

There are many benefits to vertical farming. The efficient use of space is one of the largest benefits of vertical farming. As populations grow, urban areas densify and metropolitan areas sprawl outward into traditional farming land. Vertical farms provide an alternative that allow for the growth of produce in any location. Additionally, vertical farms are often operated in vacant real estate such as obsolete industrial buildings and shipping containers located on vacant lots or within vacant buildings. This allows for the reuse of vacant real estate into a location that provides produce to the local population in an efficient way. Compared to traditional farming, vertical farms offer economies of scale to grow. For example, typically one acre of indoor vertical farming space is equal to six acres of traditional outdoor farmland.<sup>4</sup> Vertical farms also use significantly less water than traditional farms. With their closed and precise systems, vertical farms use up to 95%

<sup>4</sup> Moyer, Karen. "2021 Guide to Vertical Farming." AgHires, 1 July 2021, <https://blog.aghires.com/2021-guide-to-vertical-farming>.

less water than traditional farming.<sup>5</sup> Additionally, given the indoor operation of a vertical farm, crops are able to be grown and harvested on a year-round basis. This is beneficial in areas with colder and harsher climates where growing seasons are short and can fluctuate yearly.

While vertical farms provide many benefits to the future of alternative farming, there are some disadvantages. Vertical farms require a significant amount of upfront capital to begin operations and have high operating costs primarily from energy costs. These farms consume high levels of energy due to the controlled environment and need for extensive lighting. This is substantially more than traditional farming as well as greenhouses which depend on the sun. LED lamps consume approximately 65% of the energy while HVAC and humidifying systems consume 30% of the energy. Lastly, due to the increased overhead and operating costs, vertical farms have not been able to offer attractive pricing for selling the finished crops. The average finished cost for leafy greens in a hydroponic vertical farm is \$3.07 per pound versus \$0.65 for a traditional farm.<sup>6</sup> Vertical farming has been successfully used for higher margin crops including cannabis production as individual states have liberalized marijuana laws.

While there are pros and cons to vertical farming as an alternative farming solution, the sector is growing fast and attracting capital. Capital funding for vertical farming companies hit \$1.9 billion in 2020, nearly tripling the funding from the previous year.<sup>7</sup> Currently there are four major players in the vertical farming sector which includes Plenty, AeroFarms, Upward Farms and Bowery Farming. Upward Farms recently announced plans to open a 250,000 square foot aquaponic farm in northeastern Pennsylvania that is anticipated to be fully operational by early 2023 and will become the largest vertical farm in the country.<sup>8</sup>

### **Greenhouses:**

Greenhouses are alternative farming structures with walls and a roof made mainly of glass, that houses plants, primarily fruits and vegetables that require regulated climatic conditions to grow. These structures can range in size from small sheds to industrial-sized buildings. While there are several different types of greenhouses, commercial glass greenhouses are often high-tech production facilities which means they are built out with equipment that includes



*Greenhouse (Source: totalenergygroup.com)*

<sup>5</sup> Laurence, Emily. "Vertical Farming Will Reach New Heights." Well + Good, 2022, <https://www.wellandgood.com/fitness-wellness-trends/food/vertical-farming/>.

<sup>6</sup> Ifarm.fi. 2021. "Vertical Farms vs Greenhouses: Energy and LED Costs and Differences [Part 2 of 5]". 3 September 2021, <https://ifarm.fi/blog/2021/03/vertical-farms-vs-greenhouses-part2>.

<sup>7</sup> Walsh, Bryan. "Indoor Vertical Farming Grows Up." Axios, 26 May 2021, <https://www.axios.com/vertical-farming-e6137f78-6a73-46e6-9277-5f8d22b6a2fc.html>.

<sup>8</sup> Moss, Linda. "Vertical Farming Hits Growth Spurt With Pennsylvania Project Touted as World's Largest of Its Kind." CoStar, <https://product.costar.com/home/news/1965451907>.

heating, cooling, lighting and hydroponics along with potentially more in-depth technologies such as automated crop management. Greenhouses are best built in areas with large amounts of space, access to natural sunlight, regions with high costs of electricity and within a 6-8 hour or less drive of any cities they are serving. Due to the inherent characteristics of greenhouses, they grow crops in a single layer but use far less electrical energy than vertical farming. For example, greenhouses generally consume 1,000 kilowatt-hours per acre every year while vertical farms consume 35,000 kilowatt-hours per acre every year.<sup>9</sup> Some commercial greenhouses have even successfully become entirely self-sustainable through the recycling of water and solar panels.

Commercial greenhouses are typically built to have between one to ten acres of grow area per building. Development of these greenhouses typically use glass from Dutch-based firms and agriculture machinery from Finnish-based firms, due to their expertise in their respective fields. Greenhouse developments are mainly build-to-suit due to the highly specialized growing process and preference of specific growers.

Greenhouses provide several benefits compared to traditional farming. Among these are higher yields per square foot, less water usage, the ability to grow crops year-round and the ability to entirely control the environment of the crops which results in no risks of pests, E. coli contamination or other issues that are involved with traditional farming.

Investment and development into the space has been limited due to significant upfront costs, longer hold periods than typical investments and lower returns on average. Also, most traditionally farmed vegetables have a better profit margin than alternatively farmed vegetables, currently. However, with the growing emphasis for environmentally responsible investments, greenhouses may become a new emerging sector in the real estate industry.

### **Cannabis:**

Another area where alternative farming is playing a pivotal role is the growing of cannabis in the United States. With many states legalizing the use of cannabis, commercial growers are filling the demand. Traditionally, cannabis has been grown in a horizontal fashion under inefficient lighting structures. However, the industry has moved to vertical farming as profitability and yields have come to be the focus. Aquaponic and aeroponic vertical farming systems have become the most widely used farms for growers. These farms offer many of the same benefits to cannabis as they do to normal crops.

Cannabis has also become an emerging opportunity for greenhouse growers. Greenhouses have become essential to the growing process when vertical farming is not optimal, since many states do not have the optimal climate for growing cannabis with traditional farming. Cannabis could become an opportunity to provide a higher revenue per square foot compared to traditional vegetables and other plants grown in greenhouses. However, with cannabis still not being Federally legal, there is still

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<sup>9</sup> Ifarm.fi. 2021. "Vertical Farms vs Greenhouses: Energy and LED Costs and Differences [Part 2 of 5]". 3 September 2021, <https://ifarm.fi/blog/2021/03/vertical-farms-vs-greenhouses-part2>.

uncertainty about the ability to be an actionable investment in the space for some investors.

**Conclusion:**

As the population grows and the availability of usable farmland shrinks, alternative farming is an emerging sector to make farming more productive. While it is clear there is a need for alternative farming in the future, the best solution remains unclear. Although vertical farms offer an opportunity to produce crops at a high rate in close proximity to population centers, they require significant amounts of upfront and operating capital. Greenhouses provide an opportunity to grow year-round in a controlled environment at a lower energy usage, but require a larger land area to be effective commercially.

ORG believes there is a need for alternative farming solutions that will only accelerate in the future. While the sector is evolving and opportunities are developing, ORG will continue to monitor the industry and the ability to invest in alternative farming.

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Other Sources: Little Leaf Farms, Atlas Greenhouse, EY, AgFunder, Food Dive, Progressive Farmer, The New York Times and Scynce Led