

# Why Vertical Farming?

K. Gauri, 27628

## INTRODUCTION

Urbanization is growing all over the world and with it, an increase in spatial issue. This makes land expensive. Population increase also leads to a general hike in demand for food. But with limited space, it becomes difficult to satisfy the hunger pangs of millions of people. [2]

So as a solution to this problem, vertical farming is introduced. Growing a high yield of vegetables and fruits in a limited space such as roof tops, room walls, pillars, shelves [1] and more in contrast to the traditional farming techniques that require a large area of land.

## I. INVESTORS

Since vertical farming options are the solution for tomorrow's problem, an early investment only serves to benefit the contributors of today. Vertical farming uses led lights but uses highly efficient Light-Emitting Diodes (LEDs) this is the most beneficial for optimizing plant growth and it reduce energy costs by as much as 15% by eliminating use of other light bulbs.[2] Vertical farming has a high CAPEX but a low OPEX. Hence only an initial high investment is needed, and labor costs would be less with the use of sensors. Transportation of the goods adds to the reduction in costs and the retailers will be able to locally source the goods grown by vertical farming. [3] In the future, vertical farms will lean towards high-return and short-rotation crops and eateries nearby would purchase all the products. Vertical farming can be setup in most living spaces and abandoned buildings as well, this plays well into urbanization and farming becoming economical. [2]

## II. FARMERS

Farmers would stand a chance to compete against the export market as compared to before. Since they will be able to produce a high yield of products with a lower cost. Vertical farming also offers the advantage of continuous crop production since growth of the plants is independent of the weather conditions, as it is grown indoors. [2] With this, farmers can also abide the insect protection law that has been issued by the German government. Since growing the plants in a soilless environment eliminates the possibility of there being pest the use of pesticides is avoided. Farmers can work in a

safer environment as they avoid working with dangerous large equipment and harmful chemicals. [2]

## III. CONSUMERS

Consumers are making better choices when it comes to the question of sustainability. Vertically farmed products are almost guaranteed to offer that option. The retailers can source the vegetables and fruits (even when off season) from a local farmer (vertical farming). Which accounts for far lesser carbon footprint produced by transport of the goods alone [3]. The crop used can be considered free of pesticide, herbicide, and insecticide, ultimately the safer option for consumption. [2] Moreover, contamination of water bodies due to fertilizers in farming is reduced. Additionally, the water footprint of vertical farming is also less compared to conventional farming, as the water can be recycled with the VF technology.

## REFERENCES

- [1] Andrew M. Beacham, Laura H. Vickers & James M. Monaghan (2019) Vertical farming: a summary of approaches to growing skywards, *The Journal of Horticultural Science and Biotechnology*, 94:3, 277-283, DOI: 10.1080/14620316.2019.1574214
- [2] Birkby, J. (2016). Vertical farming. *ATTRA sustainable agriculture*, 1-12.
- [3] Pretty, J.N., Ball, A.S., Lang, T., & Morison, J.I.L. (2005). Farm costs and food miles: An assessment of the full cost of the UK weekly food basket. *Food Policy*, 30, 1-19. doi:10.1016/j.foodpol.2005.02.001

# Benefits Of Vertical Farming

Rabia Basri -27932

## I. REDUCES USAGE OF WATER AND CUTS DOWN ON TRANSPORT COST

One of the most appealing aspects of vertical farming is that it uses a hydroponic growing procedure that uses just 10% of the water. When compared to traditional agricultural practices, this method utilizes fewer fertilizers and nutrients. Because the water is entirely pure even after use, it may be properly reused, lowering the overall cost and reducing waste. When it comes to food manufacturing, last-mile distribution is sometimes regarded as the costliest component of the whole supply chain. If we know anything about farming, we're aware that crops must be transported across several oceans, countries, and even continents. Vertical farming, on the other hand, does not have this problem. This is one of the few gardening methods that allows us to grow crops almost anywhere. As a result, we may always opt to grow crops in an area where the consumer resides, lowering transportation expenses, carbon emissions, and the need to refrigerate the product on a regular basis.

## II. ENSURES CONSISTENT CROP PRODUCTION:

One of the most important advantages of vertical farming is that it is incredibly dependable. That implies that if we choose vertical farming, we can count on continuous crop output all year round. This is also made feasible by the fact that vertical farming isn't normally affected by the weather, allowing us to produce crops without being concerned about bad weather. When we farm in a totally protected and closely monitored area, we can be assured that we will have consistent crop yield. Because the influence of Mother Nature has been removed, the concept of a seasonal crop has vanished, and cultivators will not suffer losses if they try to extend the production window for seasonal cropping.

## III. USES SPACE OPTIMALLY

If we're familiar with the concept of farming, we're surely aware that it takes several acres of perfectly fertile ground. Vertical farming, on the other hand, has no such prerequisites. These farms may be designed and built in virtually any location and environment, and they will still be able to cultivate crops regardless of temperature extremes or poor weather circumstances. Vertical farming's stacking growth method is another impressive feature. This approach allows us to increase productivity on a tiny piece of land. Depending on the type of crop we want to plant, one acre of vertical farming may produce harvests that would normally take 10 to 20 acres of land to produce.

## REFERENCES

Reduces Usage of Water and Cuts Down on Transport Cost, Ensures Consistent Crop Production and Uses Space Optimally (*n.d.*). Retrieved from *Conserve Energy Future*: <https://www.conserve-energy-future.com/advantages-disadvantages-vertical-farming.php>

# Investment Opportunity and Potential

Adiel Batson, 28067

## 1.0 Why Invest?

### 1.1 The State of the Industry

Agricultural produce is largely an irreplaceable market good- everyone needs food. With a steadily growing global population, growing constraints of land use, water use and climate change, our model is a succinct answer and firm step into the direction of where food production needs to shift. We not only meet the needs of the era's most pressing socio-environmental problems, but simultaneously and synergistically develop a working road map of how best to do so.

### 1.1 Our Business Model

As a ground-up software and hydroponics company our fixed costs and maintenance inputs are expected to be relatively minimal and largely predictable compared to the agricultural industry, therefore margin for profit, relevant to expenses after initial investment, is considerably larger and more stable. Especially as a start-up, it is imperative to utilize the capital to its maximum potential, and this model, compared to traditional methods, has substantial advantages. A multi-floor system resolves land-use constraints and food security challenges by enabling a dense yield harvest per square meter of space use. Water management systems also control inputs in a looped system, avoiding soil/ groundwater pollution and perhaps more importantly, embedded industry high water-use efficiency (<95% less water-use). While solving the local problems of agriculture in the region, we simultaneously eradicate the uncertainty of climate events on crop production by managing the indoor climate conditions ourselves. Finally, without the need for large land spaces and leases, high water usage, high fertilizer input usage, heavy machinery during pre and post harvest, we save tremendously in time and resources which we can funnel directly into systems primary interfaces. When it comes to hydroponics systems, we believe they should be smart and modular. That means, high autonomy and easy scalability. This represents not only a lower complexity and uncertainty in our business model but concordantly, lower risks on a potentially higher return of investment.

### 1.2 Our Niche

Furthermore, having analyzed the state of the industry, we strongly believe we are in a niche market spot, which is relatively new, growing continuously and unsaturated. Most other organizations in the industry either focus too broad, for example, using vast scales of land and input resources to reap a climate-dependent yield, or too narrow, specializing their systems' layout to grow a few crops, with low potential for adaptation. Moreover, most business models are relatively new and developing.

What makes us unique is our access to state of the art technology, diverse, technical brain power and relentless desire to push the frontier deeper and further than before. As a team, we can rapidly find the limitations of present day models, and engineer a systematic way to overcome them.

# Pitch Paragraphs

Mohammed Abdullah, 27830, Mohammed.Abdullah@hsrw.org  
Communication and Information Engineering - Hochschule Rhein-Waal

**Index Terms**—Vertical Farming, Pitch, Investors, Farmers, Consumers

## I. INVESTORS

In 2015, United Nations predicted that by 2050 the world will reach a population of 9.7 billion.[1] This huge increase in population will need farmers to grow a lot more food than they are growing right now. Vertical farming can be a solution to this problem. This technology is still in its infancy and lots of investment is needed in this sector to develop it further. According to a research done by Emergen Research in 2020, vertical farming is currently worth 19.2 billion pounds and the market for it is increasingly growing by 20% every year.[2] They are also predicting that this industry will reach a worth of 11.7 billion US Dollars by the year 2027. All these data and the current situation in the agriculture industry suggest that vertical farming is a venture that will help the population of Earth sustain the inevitable future food crisis and also help the investors get a huge profit.

## II. FARMERS

Vertical farming is an indoor farming technique and this has some significant advantages over the traditional way of farming. One of them is superior control. Farmers can control everything plants need, for example, temperature, humidity, light, nutrition, water, etc. And a lot of these processes can be automated using various embedded systems. Vertical farms are also mostly immune to climate change and natural disaster because everything is done indoors and every aspect of plants' needs are carefully monitored and provided. Because of the same reason, it is also possible to grow some plants all year long.[3] Growing multiple crops is also possible in vertical farming. The crop yield is also much more than traditional farming as there are multiple floors of plants in vertical farming whereas there is only one in the other. Overall, in vertical farming farmers can have much more control and versatility over their crops while having much better yield than traditional farming.

## III. CONSUMERS

Compared to traditional farming, food grown in vertical farms are much healthier. Because in traditional farming, many developing countries use human or animal feces instead of artificial fertilizers.[4], [5] This can transmit various harmful infectious diseases. Instead of this, in Vertical farming natural solutions are used like, utilizing helpful insects. Vertical farms also don't use any kind dangerous of pests.[4], [6], [5], [7], [8] Foods from vertical farms are also more eco-friendly because one of the fundamental principles of vertical farming

is recycling. For example, 80% of water can be saved using recycling methods compared to traditional farming.[9] Vertical farms can also clean out the air from harmful CO<sub>2</sub> as the air quality keeps getting worse. All these benefits suggest that vertical farming is a more environmentally friendly way of producing food which benefits us and also the planet in every conceivable way.

## REFERENCES

- [1] United Nations, Department of Economic and Social Affairs, "World population projected to reach 9.7 billion by 2050," jul 2015. [Online]. Available: <https://www.un.org/en/development/desa/news/population/2015-report.html>
- [2] Emergen Research, "Vertical farming market by structure (building-based, shipping-container), by growth mechanisms (aeroponics, hydroponics, aquaponics), by offering (climate control, lighting, hydroponic components, sensors), forecasts to 2027," *Journal of Landscape Ecology*, oct 2020.
- [3] P. Platt, "Vertical farming: An interview with dickson despommier," *Gastronomica: The Journal of Critical Food Studies*, 2007.
- [4] D. Despommier, "The vertical farm: feeding the world in the 21st century," 2010.
- [5] E. Ellingsen and D. Despommier, "Opportunities and challenges in sustainability of vertical farming: A review," *CTBUH Journal*, 2008.
- [6] D. Despommier, "The vertical farm: controlled environment agriculture carried out in tall buildings would create greater food safety and security for large urban populations," *Journal Für Verbraucherschutz Und Lebensmittelsicherheit*, 2011.
- [7] J. Germer, J. Sauerborn, F. Asch, J. de Boer, J. Schreiber, G. Weber, and J. Müller, "Skyfarming an ecological innovation to enhance global food security," *Journal Für Verbraucherschutz Und Lebensmittelsicherheit*, 2011.
- [8] J. Sauerborn, "Skyfarming: an alternative to horizontal croplands," *Resource: Engineering and Technology for Sustainable World*, 2011.
- [9] D. Despommier, "Farming up the city: the rise of urban vertical farms," *Trends in Biotechnology*, vol. 31, no. 7, pp. 388–389, jul 2013.

# Pitch Proposal for Vertical Farming

D.Larose,2757

The agriculture sector has been facing several issues in recent years, from climate change, diseases, a constantly increasing population and lack of land. In order to still meet the current demand, more sustainable and environmentally friendly alternatives are needed. Vertical farming offers a concept different to conventional farming. Unlike traditional farming, in vertical farms the crops are grown upwards or stacked on top of each other in systems.(Beacham, Vickers & Monaghan, 2019) They use soil-free systems; either hydroponics, where the roots of the plants are immersed in a nutrient solution, or aquaponics, where fish and plants are combined. The fish produce nutrients waste in a tank and the water from the tank is then used. Aeroponics is also one option, the roots are sprayed with the nutrient solution. (Birkby, 2016)

One advantageous aspect of vertical farming is being able to save big quantities of water. Unlike traditional farming, no water is leached in the ground or evaporated. 95% of the water stays in the closed-loop irrigation system and keeps on being recycled. Depletion of water, over-irrigation or run-off are no longer issues. The crops in the vertical farms are monitored and controlled , no fertilisers or pesticides are used since no soil is present, making the crops bio. The controlled environment and the fact that more plants are grown per metre square allows for a greater yield. The crops can also be grown all year round, irrespective of the season.(Despoina & George, 2020) Vertical farming requires little space. The farms can be set up easily, on balconies or even inside old shipping containers that are readily available, making land availability less of an issue.

Vertical farming has rather low capital costs compared to greenhouses since they can be set up easily, for example in old shipping containers that are reused. It is however true that they have high operational costs since energy is required to keep the LEDs and the heating on and also some equipment that is constantly being used to monitor

the environment.(Despoina & George, 2020) However using outdoor land plots for agriculture also involves high costs. Most of the time the land has to be remediated so it can be used. Outdoor farming and greenhouses both have high labour costs, several people are needed, whether in the maintenance, irrigation or harvesting. Despite the high costs, vertical farming is by far one of the most sustainable farming methods that provides us with healthy fruits and vegetables.

## References

- [1] Avgoustaki, Dafni Despoina, and George Xydis. "How energy innovation in indoor vertical farming can improve food security, sustainability, and food safety?." *Advances in Food Security and Sustainability* vol. 5 (2020): 1–51. doi:10.1016/bs.af2s.2020.08.002
- [2] Birkby, J. (2016). Vertical farming. *ATTRA sustainable agriculture*, 1-12.
- [3] Beacham, Andrew & Vickers, Laura & Monaghan, Jim. (2019). Vertical farming: a summary of approaches to growing skywards. *The Journal of Horticultural Science and Biotechnology*. 94. 1-7. 10.1080/14620316.2019.1574214.

# Pitch Paragraphs

Monish Suresh, 27616

## I. INVESTORS

With the world population expected to reach up to 9.5 billion by 2050, traditional farming methods are likely to not be able to meet food requirements [1]. This makes it important to develop more sustainable farming methods like vertical farming. Vertical farms are space efficient as their vertical stacking techniques allow a one acre vertical farm to produce the same as a 10-20 acre soil based farm [2]. This low space requirement allows vertical farms to be located close to the consumers which reduces transportation costs to a large extent. It is possible for most of the vertical farming tasks to be automated which makes manual labour required for fewer tasks like managing and packing of harvests. This reduces the labour costs and requirements [3]. A current drawback of vertical farming is the high energy costs of LED lighting. However scientific studies have shown that only a very small percentage of the sunlight is used by the plant during photosynthesis which leaves room for a more efficient lighting solution to be developed [4].

## II. FARMERS

The main advantage of vertical farming for farmers is that it is not dependent on natural factors that cannot be controlled like rainfall, hours of sunlight and climate. The crops are grown in a controlled environment where the water supply, temperature, lighting, humidity, and other factors can be adjusted according to the requirements of the crop. This allows farmers to produce greater volumes of crops, including seasonal crops, throughout the year. The crops are grown in a closed environment which prevents the entry of pests and the ability to control the humidity of the environment reduces the chances of a fungal infection [3]. This absence of pests contributes to increased crop yields. Since the crops are grown using soilless techniques like hydroponics or aeroponics, they are also protected from diseases that spread through the soil [5]. Vertical farming has much fewer occupational hazards compared to traditional farming as they do not require the use of heavy machinery and strong chemicals.

## III. CONSUMER

Since vertical farms can be set up in cities, they tend to be physically closer to their consumers. This means that the products will spend less time in travel in order to reach shops and the consumers will get access to more fresh products. The use of closed controlled environments for vertical farms allows them to be protected against pests which cuts down on the use of pesticides and other strong chemicals on the crops by a large

extent. This lack of pesticides make the crops more organic and make them healthier and safer for consumption. The controlled environment in vertical farms also allows crops to be grown throughout the year. This gives consumers access to seasonal crops all year long. Vertical farms also provide consumers with the possibility of growing crops in their own homes. Companies like the Munich based Agrilution sell vertical farming kits that allow consumers to grow plants like herbs and microgreens in their homes [6].

## REFERENCES

- [1] "4 Ways to Start Investing in Vertical Farming," The Impact Investor, 12 April 2021. [Online]. Available: <https://theimpactinvestor.com/investing-in-vertical-farming/>.
- [2] "The 10 biggest advantages of vertical farming," hortidaily, 31 January 2020. [Online]. Available: <https://www.hortidaily.com/article/9183371/the-10-biggest-advantages-of-vertical-farming/>.
- [3] Conserve Energy Future, "Advantages and disadvantages of vertical farming," Conserve Energy Future, [Online]. Available: <https://www.conserve-energy-future.com/advantages-disadvantages-vertical-farming.php>.
- [4] E. Kobayashi-Solomon, "Investing In Vertical Farming: Five Take-Aways," Forbes, 5 April 2021. [Online]. Available: <https://www.forbes.com/sites/erikkobayashisolomon/2019/04/05/investing-in-vertical-farming-five-take-aways/?sh=45257f38355c>.
- [5] Eponic, "Advantages of Vertical Farming," 16 October 2020. [Online]. Available: <https://www.eponic.com.au/advantages-of-vertical-farming/>.
- [6] Agrilution, [Online]. Available: <https://www.agrilution.com/>.

# Why choose Vertical Farming?

Rajshree Jeewon, 26941

## 1.0 Vertical Farming: The solution of the future?

The world population is expected to reach 9.7 billion by the year 2050 and probably 11 billion by the year 2100 according to the United Nations (United Nations, 2019). With a decline in conventional farming and a rapid pace of urbanization, there needs to be an innovation in the method of food production, otherwise all those 9.7 billion people will starve causing mass hunger (The Impact Investor, 2021). Vertical farming seems to be the solution for the increasing food requirement in the future. In addition to being sustainable, vertical farming deals with a major social issue. It is a form of controlled environment agriculture (CEA) which uses modern technology and data science for a produce of fresh crops all year round while maximising the horizontal as well as vertical space (Cambridge Hok, n.d.). The growth rate of this type of farming is anticipated to be over 24 % in the upcoming 5 years (The Impact Investor, 2021).

### 1.1 How to Vertical Farm

There are different aspects that need to be considered for vertical farming such as the physical area, medium, light and sustainability. The main goal is to produce a higher yield of crops with limited space. Hence, different constellations are used in which crops are grown vertically or using the stacked horizontal systems which helps minimise space compared to conventional farming. Secondly, soil is not used, rather systems like hydroponic (where the crops grow in nutrient-rich solution), aquaponic (where the hydroponically-grown crops are fed with nutrient-rich aquaculture water) and aeroponic

(in which plant roots are sprayed with nutrient water mix) are used. Furthermore, using the latest technologies, each plant receives the right dose of light. In comparison to traditional farming, vertical farming makes use of 95% less water which is a huge advantage on the dwindling water supply, hence making it sustainable (The European Business Review, 2020). The optimum conditions for plant growth are monitored and adjusted for each plant, producing a higher yield all year round independent of the harsh conditions of the changing weather such as heatwaves, storms, droughts and so forth.

### 1.2 Why invest in Vertical Farming?

Vertical farming turned out to be very favourable to humans in various ways. The crops are pesticides-free which results in an advantage to both consumers and farmers. Less damaging impact is made on the environment and the farmers are exposed to less bugs and pesticides. The consumer gets a higher quality product that's healthier and available all year round. With an outdoor farming business, a lot of farmers faced various problems with the quality or supply chain throughout the year. With indoor farming, the growers have a higher yield per year and a lower risk of harvest failure due to external weather conditions. Additionally, new products can be introduced to the market as the crop growth is independent of the local climate (Mark Abssy, 2021). Vertical farming is an emerging market with a new technology and it may be the solution to a lot of problems faced by the population. It can feed an ever-growing population in a sustainable and affordable way. This new innovative type of farming makes use of less water and space than traditional farming, does not depend on the weather and

is incredibly beneficial to humans (The European Business Review, 2020).

### **1.3 References:**

The Impact Investor (2021), “4 ways to start investing in vertical farming”. Accessed on <https://theimpactinvestor.com/investing-in-vertical-farming/>

The European Business Review (2020) “Vertical farming is the future”. Accessed on <https://www.europeanbusinessreview.com/vertical-farming-is-the-future/>

United Nations (2019), “Growing at a slower pace, world population is expected to reach 9.7 billion in 2050 and could peak at nearly 11 billion around 2100”. Accessed on <https://www.un.org/development/desa/en/news/population/world-population-prospects-2019.html>

Cambridge Hok (n.d.), “Should I invest in vertical farming”. Accessed on <https://cambridgehok.co.uk/news/should-i-invest-in-vertical-farming>

Mark Absy (2021), “Vertical Farming: The Big Build Up”, - Rize. Accessed on <https://rizeetf.com/2021/05/vertical-farming-the-big-build-up/>



# Pitch Paragraphs

Yongyi Wang , 27634

## I. INVESTORS

Vertical farming is the future trend of agriculture, more and more places are adopting this technique to produce food locally. Many big companies such as SoftBank Vision and Amazon's CEO Jeff Bezos, have also invested in vertical farming.

Vertical farming has a lower risk as it is set up under a controlled environment. Many factors that traditional agriculture is dependent on like weather, sunlight, and water will not affect the production of vertical farming. Since all conditions are controlled technically, less manpower is needed and food can be produced locally. Therefore, less transportation cost and more environmentally friendly.

Most importantly, vertical farming gives a much higher yield than traditional agriculture (seen in figure 1). Lessor no fertilizers will be needed during the process which is also aligned with many EU directives.

In conclusion, vertical farming is sustainable and worth investing in with low risk.

Crops	Yield in VF due to Tech (tons/ha)	Field Yield (tons/ha)	Factor increase due to Tech	Factor increase due to Tech and Stacking
Carrots	58	30	1,9	347
Radish	23	15	1,5	829
Potatoes	150	28	5,4	552
Tomatoes	155	45	3,4	548
Pepper	133	30	4,4	704
Strawberry	69	30	2,3	368
Peas	9	6	1,5	283
Cabbage	67	50	1,3	215
Lettuce	37	25	1,5	709
Spinach	22	12	1,8	820
Total (average)	71	28	2,5	516

Source: Designed in a CE Study by the author at DLR Bremen.

Figure 1: Estimated yield of vertical farm compared to traditional agriculture.

## II. FARMERS

Due to the climate change world widely, traditional agriculture will face more difficulties in the future. Extreme weather and natural disaster will have a more severe impact on the yield of crops. Moreover, land fertility will also be affected by these catastrophic events.

By using vertical farming, all the problems will be solved, with all the light, water, and nutrients controlled technically. The plants will grow under ideal conditions. Moreover, the farming process will be less exhausting for farmers and less manpower is needed.

According to the CBI, Germany has imported 10.9 billion worth of euro's fruits and vegetables in 2017. Vertical farming will also boost local food production, thus less external competition from imported food. With less competition, more food can be sold locally and with higher profit.

## III. CONSUMER

With vertical farming, consumers can enjoy fresher and cheaper vegetables. As more food can be produced locally, less transportation fee is needed, the price of the food will then be lower than the imposed food. Also, with less transportation of food, more nutrients can be conserved in food (Seung K. Lee, Adel A. Kader). Moreover, less refrigerating or waxing is needed to keep the food fresh on the way. This also makes the food healthier and more environmentally friendly.

Organic food is also a big trend for a healthier diet now, with vertical farming, all the food will be organic.

More importantly, the food will be pesticide-free and thus healthier. Under a controlled environment, and hydroponic techniques used to grow the plants, no fertilizers and pesticides are needed during the process.

All in all, choosing vertical farming food is beneficial for both the health of humans and the environment.

## REFERENCES

1. CBI, Exporting fresh fruit and vegetables to Germany, February 2019  
<https://www.cbi.eu/market-information/fresh-fruit-vegetables/germany>
2. Seung K. Lee | Adel A. Kader, November 2000, Preharvest and postharvest factors influencing vitamin C content of horticultural crops, Volume 20, Issue 3,  
<https://www.sciencedirect.com/science/article/abs/pii/S0925521400001332>
3. Lucle Adenauer, November 2014, Estimated yield of vertical farm compared to traditional agriculture. [https://www.researchgate.net/figure/Estimated-yield-of-a-Vertical-Farm-compared-to-traditional-agriculture\\_tbl1\\_259702659](https://www.researchgate.net/figure/Estimated-yield-of-a-Vertical-Farm-compared-to-traditional-agriculture_tbl1_259702659)
4. Leanna Garfield, January 2018, A Jeff Bezos-backed warehouse farm startup is building 300 indoor farms across China  
<https://www.businessinsider.com/vertical-farming-company-jeff-bezos-plenty-china-2018-1>

# Pitch Paragrahps

Ömer Özgün Üngüder-27523-Oemer-Oezguen.Uengueder@hsrw.org  
 Communication and Information Engineering - Hochschule Rhein-Waal

## I. INVESTORS

Germany is the fourth biggest economy in the world in terms of GDP with 1.44T \$ total exports and 1.16T \$ imports. Vegetable goods account for approximately 3% of the total import and it costs 34.2B \$ to German economy on yearly basis. These figures show that there is a huge potential in meeting the market demand. Given the product range, which could be produced with the VF methods, potential market has a value of 2989 million \$. This value is calculated for the vegetables such as cabbage, tomato, lettuce, pepper and cucumber. On the figure below, it is shown the percentages of mentioned vegetables in imports of Germany.[1] By establishing of a commercial-size VF applications, any investment made in this area, could bring possible high returns by filling the gap in the vegetable goods market.

Coffee	Rapeseed	Other Nuts	Other Vegetables	Other Live Plants			
9.22%	7.01%	5.8%	5.39%	4.81%			
Other Fruits	Corn	Wheat	Pitted Fruits	Apples and Pears	Frozen Vegetables	Frozen Fruits and Nuts	
4.5%	3.24%	2.19%	2.02%	1.98%	1.85%	1.81%	
Tomatoes	Bananas	Cucumbers	Lettuce	Rice	Onions	Potatoes	Perfume Plants
4.27%	2.75%	1.75%	1.27%	1.25%	1.1%	1.05%	0.98%
Citrus	Soybeans	Coconuts, Brazil Nuts, and Cashews	Cabbages	Subs and Roots	Other Dry Seeds	Seeds	Tea
3.69%	2.68%	1.68%	0.91%	0.71%	0.71%	0.68%	0.67%
Cut Flowers	Grapes	Vegetable Saps	Barley	Foliage	Pepper	Rye	Clava
	2.48%	1.52%	0.9%	0.56%	0.54%	0.2%	0.1%
3.59%	Melons	Root Vegetables	Dried Vegetables	Spices	Unseeded	Unseeded	Unseeded
	1.32%	0.76%	0.75%	0.4%	0.2%	0.2%	0.2%
3.59%	Tropical Fruits	Sowing Seeds	Sunflower Seeds	Sunflower Seeds	Sunflower Seeds	Sunflower Seeds	Sunflower Seeds
	2.34%	1.31%	0.75%	0.75%	0.75%	0.75%	0.75%

Fig. 1. Imported vegetable goods in Germany.[1]

## II. FARMERS

In the agricultural industry in Germany, main expenditure on production of vegetables is the energy costs, which are roughly 3 Billion \$.[2] With the VF applications, one of the energy cost item, water used 3000 liters/person/day [3], can be reduced to 80-90 % of the water consumption in conventional farming.[4][5]

In addition to the less water usage in farming, VF also provides maximizing the crop production compared to the

traditional farming. The yields taken from 1 acres is equivalent to 10-12 times of the soil-based production. Many vegetables can be produced independent of seasons and due to the closed and controlled environment in VF, there is no weather related crop failures.

## III. CONSUMERS

Since the climate change and the efficient use of world’s resources have become an important issue for the future of the world, people started to think about their food preferences. Therefore, eco-friendly productions take more attention day by day and demand over them is constantly increasing. VF farming gives a hand to the people, who has concerns on the sustainability of the world, by supplying qualified, clean and nutritious product. Consumer can contribute to the world by choosing VF product over the conventionally produced vegetables. In VF, less water is used to produce the same amount of products. Additionally, reduced use of the fossil fuels in these production facilities can drop the carbon footprint. Moreover, due to the fact that there is no seasonal limitation in the vegetable production, fresh pesticide-free vegetables could be available to the customers in everyday of a year.

## REFERENCES

- [1] Datawheel. (2021, Oct.) The observatory of economic complexity. Online. Accessed on 26.10.2021. [Online]. Available: <https://oec.world/en/profile/country/deu?depthSelector2=HS4Depth>
- [2] (2021, Jun.) Germany: agriculture statistical factsheet. Online. European Commission. Accessed on 26.10.2021. [Online]. Available: [https://ec.europa.eu/info/food-farming-fisheries/farming/facts-and-figures/performance-agricultural-policy/agriculture-country/eu-country-factsheets-0\\_en#overview](https://ec.europa.eu/info/food-farming-fisheries/farming/facts-and-figures/performance-agricultural-policy/agriculture-country/eu-country-factsheets-0_en#overview)
- [3] V. Mendez Perez, “Study of the sustainability issues of food production using vertical farm methods in an urban environment within the state of indiana,” Master’s thesis, Purdue University, 2014.
- [4] T. Kozai, *Plant factory : an indoor vertical farming system for efficient quality food production.* Amsterdam: Academic Press, 2015.
- [5] D. Despommier, “Farming up the city: the rise of urban vertical farms,” *Trends in Biotechnology*, vol. 31, no. 7, pp. 388–389, jul 2013.

# Reasons For Choosing Vertical Farming

Md Samiul Haque-27930

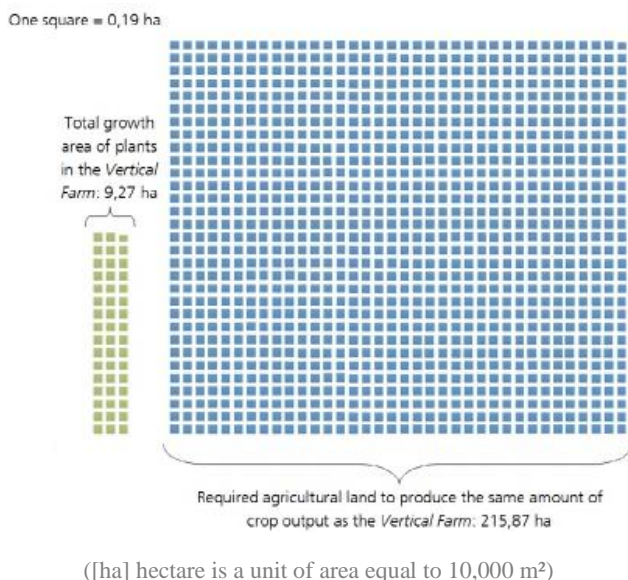
## I. CROP OUTPUT IS CONSISTENT ALL YEAR.

The most significant advantage of vertical farming is that it is not weather dependent, which means we can achieve continuous year-round crop production without worrying about the influence of unfavourable weather conditions on both quality and profile of production and yield. Farming in a secure, well-monitored, and controlled environment provides producers with certainty and peace of mind by delivering repeatable, programmed output.

By removing the influences of Nature, there is no such thing as a 'seasonal crop,' and producers will not experience losses as they attempt to stretch the output windows of 'seasonal farming.'

They may also successfully shorten harvest periods and increase production while maintaining 100% consistency in flavor and quality. However, when planned and handled appropriately, an indoor vertical growing system has repeatedly demonstrated increased flavor and storage stability.

## II. IMPROVED SPACE UTILIZATION



**Fig. 1.** Vertical farming comparison with regular farming

Professor Despommier of Columbia University introduced the concept of contemporary vertical farming in 1999. The plan was to construct a skyscraper farm capable of feeding 50,000 people.

Recent technological advancements, such as efficient lighting, soil - free growth, and system automation, have boosted vertical farming crop yields to

ten times that of conventional agriculture! As a result, a much smaller piece of land is required to make the same amount of food as a typical field. This is especially crucial in and around big cities, where land and property are costly and open area is limited.

Vertical farming has a smaller impact on plants and animals in local environments since it takes up less room for growth. Thus, vertical farming has several advantages and has been shown to be helpful to both the environment and humanity. Implementing vertical farming may be a healthy and profitable strategy for saving environment for future generations.

## III. REDUCES TRANSPORTATION COSTS

When it comes to food manufacturing, last-mile distribution is sometimes regarded as the most expensive component of the whole supply chain. If we're familiar with the agricultural process, we're aware that crops must be transported across several oceans, countries, and even continents.

Vertical farming, on the other hand, does not have this problem. This is one of the few gardening methods that allows us to grow crops almost anywhere. As a result, we may always choose to cultivate crops in an area where our consumer resides, lowering transportation expenses, carbon dioxide emissions, and the need to constantly refrigerate our food.

At the end of the day, this not only adds to the freshness of our goods, but it also increases their profitability.

## REFERENCES

- Crop output is consistent all year (n.d.). Retrieved from *hortidaily*:<https://www.hortidaily.com/article/9183371/the-10-biggest-advantages-of-vertical-farming/>
- Improved space utilization (n.d.). Retrieved from *eponic*:  
<https://www.eponic.com.au/advantages-of-vertical-farming/>
- Conrad Zeidler, Daniel Schubert, "From Bioregenerative Life Support Systems For Space To Vertical Farming On Earth,"
- Reduces transportation costs (n.d.). Retrieved from *conserve-energy-future*: <https://www.conserve-energy-future.com/advantages-disadvantages-vertical-farming.php>

# ARE VERTICAL FARMS THE SMART ALTERNATIVE TO ACHIEVE SUSTAINABLE AGRICULTURE?

*Leen Skaf, 27826*

## **Does Vertical Farming appeal to Farmers?**

Vertical Farming (VF) is a significant step towards a more sustainable agricultural sector. Recently, all hydroponic, aeroponic, and aquaponic systems spreading worldwide prove that they can facilitate agriculture, reaching ecologically and economically sustainable agriculture. Hydroponic systems can grow up to 20 times more crops while using only 8% of the water usually used in traditional agricultural fields (Vyas, 2021). One of the lead VF companies called “Bowery,” located in the UAE, claimed that a soilless farm could produce 100 times more crops for the same space than conventional farms (Vyas, 2021). Another attractive aspect for the local inhabitants is being self-sufficient regarding food. The Swedish food tech company “Plantagon” took the initiative and used the urbanized region to integrate the greenhouse concept into VF and feed around 5000 people of the building. As claimed, those vertical greenhouses are highly automated, so they do not require high plants maintenance (Vyas, 2021). Controlling nutrient levels and temperatures in VF speeds up the growth rate and improves the nutritional values of the crops. This further helps with the marketing procedure of having an adjustable taste of products, boosting the farmers' credibility! (Stark, 2019).

## **Are Vertical Farms Financially Rewarding To Investors?**

Yes, they are! Vertical farming (VF) is a reasonably new technology compared to standard horticultural techniques. Hence, high initial capital is expected. The costs of real estate lands in an urbanized area are realistically higher than in rural areas where regular farms exist. Further, since VF systems have a controlled environment, additional fees are required to maintain temperature, lighting, and water balance. All of the aspects above are more or less just to be taken care of at the start. Once the constellation is running, a stable income from food production will be sustained. Feeding highly dense urbanized areas will be profitable because all the fuel price fluctuations' concerns about shipping food are gone!. Moreover, extreme climate change events such as floods and droughts, which eat up natural arable land, are no longer relevant to agricultural investors (Stark, 2019). VF will become more stable and affordable as climate change endangers land and natural resources more and more.

Again, yes, VF are economically viable and worth investing in implementing these projects globally.

## Why Should We Consume Vertical Farming Products?

Crops produced on vertical farms (VF) are well-protected from diseases, and their environment is safe from climate change impacts. The recirculation water systems save up to 90% of the water used in traditional farming. Since fertilizers are accustomed to each farm, yield can be raised, and the growth period for each plant can be minimized (Vyas, 2021). A company called “ModularFarms” developed self-sufficient containers, where all environmental conditions are secured. It also promoted modularity, where VF can be scaled rapidly in terms of size and the kinds of crops growing (Vyas, 2021). Bearing all that in mind, consumers can reduce their ecological footprint by using their backyard to produce their food demands. There will be no need for separate arable lands anymore. The CEO of an agricultural technology company named “Alesca life” claimed that VF helps with climate adaptation by providing various controlled environments to produce food efficiently rather than preventing damage in traditional farms (Rowley, 2019).

Who wouldn't like an easy nearby production of their vegetables? VF always gives you an opportunity whether you want to produce on a large scale for a whole urbanized city or supply your family with a daily delicious green salad!

## References

1. Kashyap Vyas, 2021, “13 Vertical Farming Innovations That Could Revolutionize Agriculture” These revolutionary vertical farming innovations might just be the future of food, Interesting Engineer. Accessed on 25 Oct 2021:  
<https://interestingengineering.com/13-vertical-farming-innovations-that-could-revolutionize-agriculture>
2. Krista Stark, 2019, “Economic Viability of Vertical Farming: Overcoming financial obstacles to a greener future of farming”, Duke, Nicholas school of the environment, US environmental policy. Accessed on 25 Oct 2021:  
<https://blogs.nicholas.duke.edu/env212/economic-viability-of-vertical-farming-overcoming-financial-obstacles-to-a-greener-future-of-farming/>
3. Melissa Jun Rowley, 2019, “Is vertical farming the future of food production?”, Global Center on Adaptation. Accessed on 25 Oct 2021:  
<https://gca.org/is-vertical-farming-the-future-of-food-production/>

# Vertical farming sales pitch

Jiajun Chen, 27775, Jiajun.chen@hsrw.org  
 Communication and Information Engineering - Hochschule Rhein-Waal

***Index Terms***—Vertical Farming, Pitch, Investors, Farmers, Consumers

## I. INVESTORS

Farming is an essential aspect of human civilization. In recent years, the world has experienced a loss of resources unprecedented in history, with difficulty to maintain production of nutritious foods increasing by the day, to keep up with the world's growing population. One of the solutions to this phenomenon that should be proposed in vertical farming and the rapidly expanding market capitalisation is representative of the attention it has attracted from consumers and investors alike. Currently worth €3.6bn, the global market for vertical farming is growing by 20% a year and is forecast to reach a staggering €20bn by 2028, according to California based Grand view research inc. This is a genuine opportunity to invest in this industry's early beginnings to net a return on investment while contributing towards something that positively affects the planet.

## II. FARMERS

The covid-19 epidemic and rising political tension around the globe has caused severe disruptions to supply chains in recent years, with restaurants and hotels closing down, desirable produce such as potatoes have nowhere to go, with farmers forced to liquidate billions of pounds of their own yield becoming a common sight. These actions are not only wasteful, unethical but also warrants a revision of the traditional farming industry as a whole. It should be noted that there exists a great way to diversify the production of high quality foods for both existing farmers and would-be members that want to get into the agricultural industry; this is vertical farming. Where the highest quality, clean, pesticide free vegetables are sold with a premium price to increase the margins to greatly supplement any existing agricultural business.

## III. CONSUMERS

Increasing population, climate change, over-utilisation of cultivable land, security of food quality, water shortage, and other challenges shouldn't be matters of concern to a select few but all of us as consumers. In a time where the world is literally resource strained, we must vote with our wallets and choose the product we buy to consume consciously, rather than leaving the responsibility to faceless corporations who only see in numbers. This can be achieved by actively choosing to purchase produce grown in vertical farms, where high quality vegetables are grown in environmentally responsible ecosystems that save 95% water compared to traditional farming.

Additionally, making such a conscious purchase would also net you a reward in personal health, as our lives are prolonged compared to previous generations, it's now occurring to people to be more aware of what they're putting in their own bodies to reduce risk of cancer and diseases. These are just a few of many examples of why we should explore and learn about vertical farming.