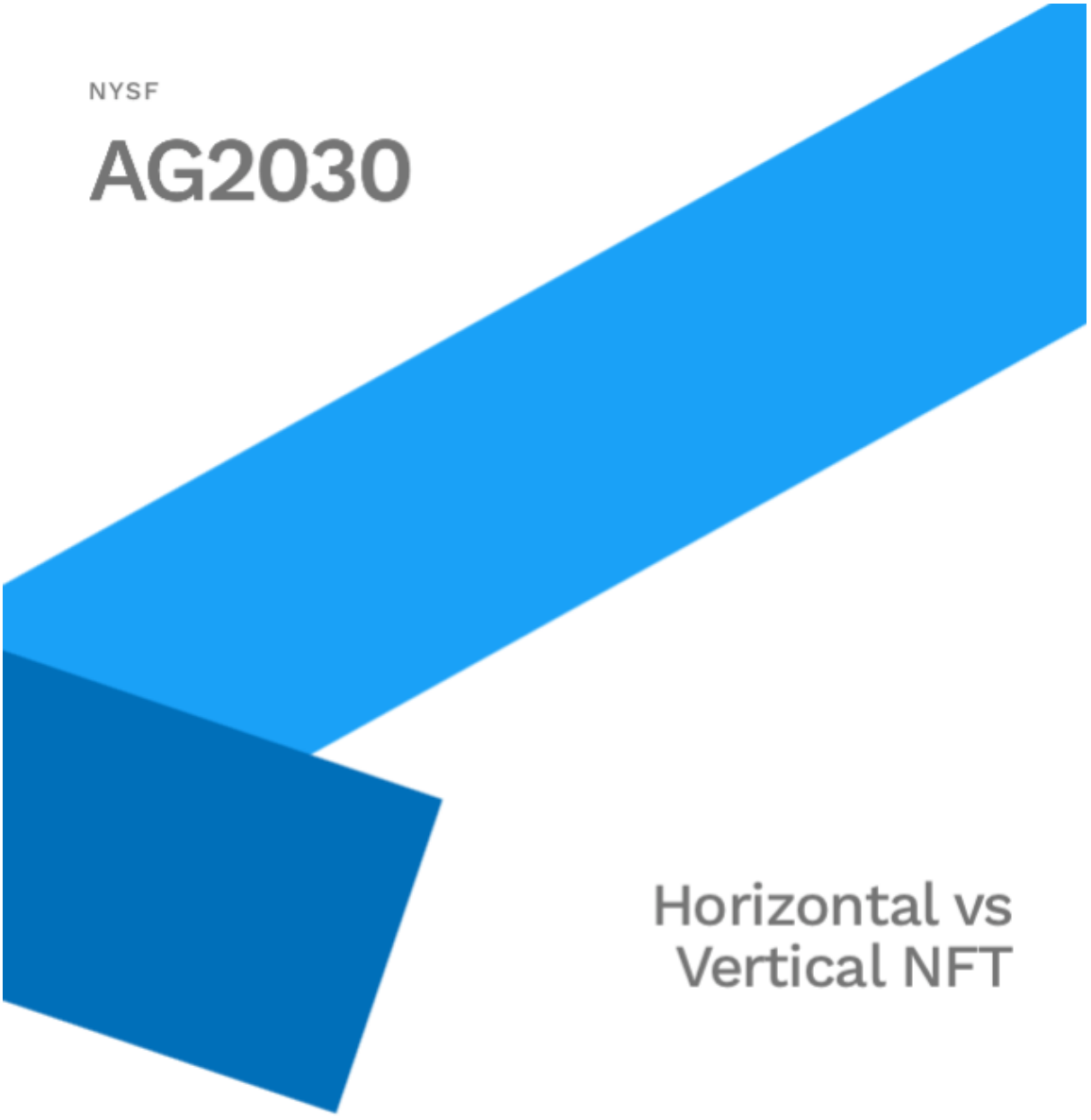
NYSF

AG2030



Horizontal vs Vertical NFT

Introduction

From what has been previously discussed it is seen that the vertical farming model has more merits than the current open field model for the future of agriculture. Unlike the current model that is only consistent with one intractable design, Vertical farms are seen to have a widespread of designs with abundances of customizability. With our selection of the aeroponic solution to meet the requirement for the AG2030 project a design that is best suited for the Australian agriculture sector must be considered in terms of best utility. There are many designs currently being employed in the industry overseas with varying capabilities defined as being constructed in the vertical and the horizontal plane.

Horizontal plane

The horizontal plane design of vertical farming architecture is the most commonly seen in the commercial vertical farm industry. The adoption of this design was taken up by companies such as Aerofarms, Bowery Farming, and other vertical farming companies. The main focus of the design is to utilise modular components that are stacked on top of each other and often are housed in large industrial warehouses. Design requires installing lights in the bottom of the modular component to provide a light source needed for the plant to experience growth. These designs are proprietary and often include software to help manage optimum led lighting spectra, fertiliser input and airflow to help reduce unwanted mould growth. As part of the proposal our group had developed a prototype of a scaled-down version of this design seen below:

One of the major advantages of this system is that it can support a variety of plants. This makes this type of system extremely versatile in its application with it being able to support large and smaller plants. The ongoing maintenance of the actual system is quite minimal. This is due to its simplistic design and usage of a small number of parts.

The disadvantage with this model of vertical farming is that the lateral growing systems often require a person in a scissor elevator lift to service one row of tiers and spend time moving up and down. Not only are scissor elevators cumbersome, expensive, and dangerous, but they also reduce the space for several modular components for the space provided. A study conducted by herb-ponic found that with 64 square feet of available space for the farm 32 square feet was used for the growing of produce. This leads to a ratio of one half of a square foot of productive space per square foot of available space. Another major problem with this model is that the harvesting and maintenance of the operation are significantly higher than vertical NFT systems. This is down to more labour cost which is seen to account for 25% more than a vertical plane system. Expansion of the farm can also be costly. The opportunity costs of additional tiers are substantially high with every new tier operating at loss during the first year.

Summary of the advantages and disadvantages

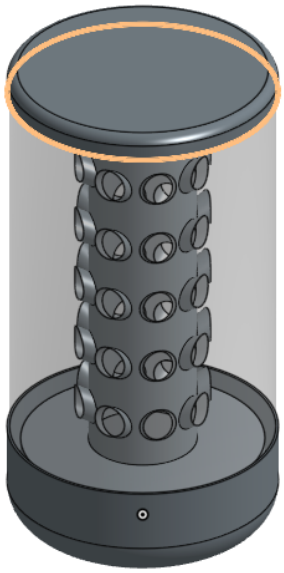
Advantages

- Arguably easier to maintain because there are less parts in a system.
- Simpler and easier to set up.
- Allows for larger plants to be supported due to less weight being borne by the system Even lighting conditions for all plants grown

Disadvantages

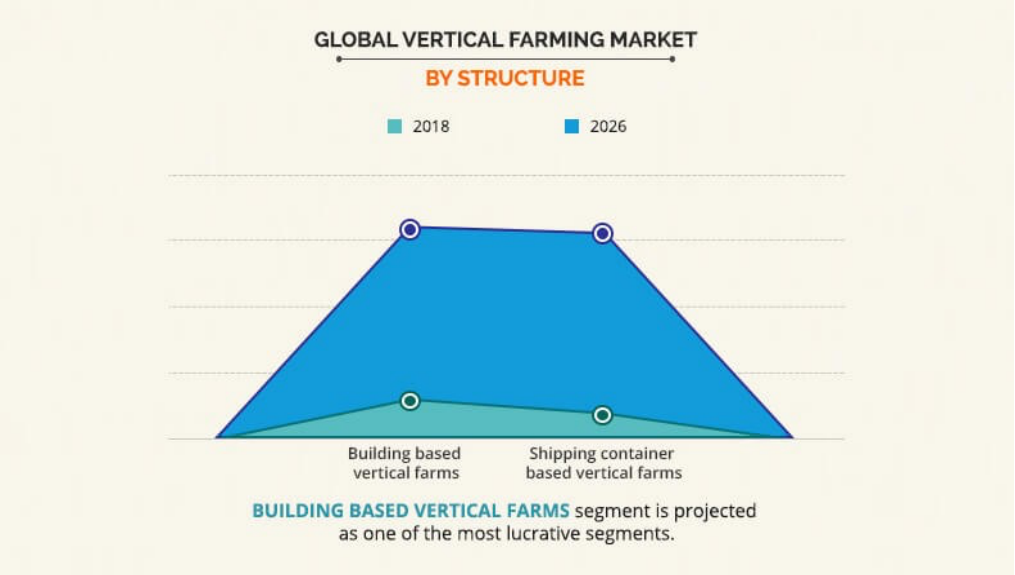
- Consumes significantly more space
- Not as high yield as vertical NFT systems
- Harvesting is more difficult especially for net pots in the middle of the rows of channels
- More expensive material must be incorporated in the design

Vertical plane



The vertical plane model utilises a cylindrical unit that can house a multitude of plants. Unlike the lateral model for vertical farms, this model can utilise natural sunlight. This is due to each farming being a standalone unit, unlike the modular approach that stacks these farming units. However, with our prototype (seen on the left) we do not utilise the system's ability to utilise natural light. The main focus of the design is to retain as much water as possible as specified in the AG2030 project as being one of the major focal points. The prototype utilises an enclosed system that aims to capture any excess water by condensing on the glass. The bottom of the prototype is curved to funnel the condensed water back into the pump to be utilised again.

A benefit to vertical plane growing systems can have plants growing on both sides of the plane allowing them to maximise the amount of produce in the available space. This highlights growing in the vertical plane is usually a more efficient use of space than in the horizontal plane. Another advantage of the vertical model is the growing setup is its accessibility, allowing workers to access any row they need to care for crops at ground level without bulky equipment such as a scissor lift. Additionally, harvesting is much less labour intensive with vertical growing plane systems in vertical farming, this is due to the accessibility from the ground level. This accessibility to the vertical farm is key to reducing labour costs. As discussed in detail above, the advantage once again falls with vertical growing planes that do not have stacked rows of plants. Horizontally stacked rows of plants are not efficient to harvest, monitor, or otherwise tend to. The less efficient a method is the more time needed to be dedicated to its management which causes it to have more labour costs. Due to the smaller labour cost, the vertical plane farm can maximise on profit illustrated in the chart below:



The main disadvantage of this vertical model is that more powerful pumps are needed to pump the nutrient-rich solution to the plants. This is due to more work needing to be done by the pump as the water is being pushed down by the forces of gravity as the height increases. Another disadvantage is that each plant is exposed to different levels of light. This is more pronounced with the bottom row of plants. This can affect the growth rate of the plant and can affect the quality of the produce. With the current vertical farm model, it is unable to support large plants. This limits the variety of plants being able to be grown on this system and this in turn also limits the size of plants that can be grown on the system. The final major flaw in this system is that it is relatively harder to set up than a horizontal plane farm.

Summary of the advantages and disadvantages

Advantages

- More compact and more space efficient since grow channels can be stacked on top of each other
- More profitable
- Allows for greater yield since plants are not allowed to grow larger unlike in horizontal NFTs.
- Harvesting is easier to do since the plants are more easily accessible.

Disadvantages

- Requires a more powerful pump to make sure the nutrient-rich solution can reach a certain level
- More difficult to set up however pre-made setups alleviate this issue.
- Uneven lighting conditions especially for plants at the bottom row which may necessitate the implementation of grow lamps.
- It cannot allow plants to grow larger than what the system can reasonably bear.

Conclusion

When reviewing the advantages and disadvantages, both designs have their merits. However, when reflecting on the main objective assigned for the AG2030 project and the goal that is wanted to be achieved by the end of 2030. It is recommended that the Australian agriculture sector should adopt a vertical plane aeroponic system in tangent to still depend on open-field farming. The reason for the implantation of a vertical plane system over a lateral plane system is its relatively smaller set-up cost, its potential to be highly profitable and its ability to expand. Secondly the technology needed to make lateral plane farming more viable does not currently exist. An example of how and where this design can be implemented can be seen in the Murray-Darling Basin. This area can serve to be one of the first vertical farms constructed in Australia and can be used to prompt the potential of vertical farms in an area where there is a limited amount of water. This would also serve to be an economic boost in a small regional area by providing new job opportunities and tourism. Beyond the project the implantation of vertical farming is essential in feeding the next generations. After the project has completed its aim and with the further advancements in technology such as automation. The lateral plane of vertical farming will prove to become the future of agriculture.

Sources

Storey, A., 19, S.N.on J. & *, N., 2019. The beginner's guide to the Indoor Farming Industry. *Upstart University*. Available at: https://university.upstartfarmers.com/blog/indoor-farming-industry

Anon, 2021. Vertical farming 2021 (The mega report). *Vertical Farming 2021 (The MEGA Report)*. Available at: https://www.urbanvine.co/blog/vertical-farming#vertical-farming-design-architecture

Anon, 2021. Vertical farming 2021 (The mega report). *Vertical Farming 2021 (The MEGA Report)*. Available at: https://www.urbanvine.co/blog/vertical-farming#vertical-farming-design-architecture

Andrea, 2021. Horizontal vs vertical NFT hydroponics: Which one is better? – your indoor herbs and garden. *Your Indoor Herbs and Garden | Start an Herb Garden In Your House Today!* Available at: https://www.yourindoorherbs.com/horizontal-vs-vertical-nft-hydroponics/ [Accessed

Rotko, O., 2021. What is vertical farming? the most common vertical farming designs. *Home*. Available at: https://arcticfarming.fi/blog/what-is-vertical-farming