

Vertical Farming as a Unique Solution for Future Agricultural Challenges

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Abstract. Future challenges or the unrelenting human mind provide us with new ideas that make the unthinkable a reality, changing all our representations of how things might be done in a completely different and more beneficial way. It was inevitable that the agricultural sector would change dramatically over the years, as new challenges were not considered in traditional farming. Vertical farming is a new way of growing some vegetables in a more unique way that benefits in many aspects. The novel aspect that might find a new discoverer of the technique is no soil usage in growing vegetables. There are other aspects that put this technique ahead in some cases. This article will focus on explaining what vertical farming is and also its advantages and disadvantages. Also, the future application of the technique will be covered.

1 Introduction

It is unbelievable how new approaches, technological devices, and other innovative equipment continue to emerge, even though it may seem that every possible discovery has already been made. Nevertheless, progress does not remain stagnant but constantly moves forward, introducing novelties that have a significant impact on humanity. One could argue that it is almost impossible to come up with a new idea, as nearly every conceivable thought has been thought of by someone, if not many. However, as mentioned earlier, progress is not stationary; thus, new breakthroughs open up different possibilities for imagination. Another factor influencing the generation of new ideas can be negative circumstances, such as global warming, overpopulation, natural disasters, and wars. These factors greatly push the almost stagnant world to new limits, resulting in new opportunities for breakthroughs.

Recently, the focus has shifted toward the farming industry, particularly agriculture. New challenges, such as overpopulation, natural disasters, and related issues, have put agriculture in jeopardy, both for the present and the future. Agriculture is currently going through a challenging phase, as it must first meet the demands while undergoing significant changes in terms of regulations, methods, and approaches. Therefore, the agricultural sector needs to be reevaluated, and new innovative methods need to be incorporated in order to adapt to the changes occurring in the sector [1, 2].

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As mentioned earlier in this work, new approaches are the driving force behind the chosen sector. Consequently, this work will look into vertical farming. This approach is not new in the sense that it is being introduced to the world for the first time through this work. Vertical farming has been in existence for a while and has already been utilized with positive outcomes. Vertical farming is a promising approach with its advantages and, undoubtedly, some drawbacks. Nonetheless, this work will attempt to outline its nature and illustrate all the major aspects within the agricultural sector."

2 Need for a New Ways of Handling Modern Challenges

While technological progress is thriving with new innovative ideas, there are aspects that remain unresolved or become more acute, potentially causing problems in the near future. New ideas are the solution to these problems [3]. However, 'new' does not necessarily mean something is good; it may be advantageous in one aspect but detrimental in others. Therefore, innovative ideas must be carefully evaluated before implementation in a given sector to ensure they perform better than the previous methods.

Vertical farming does address certain issues that have long been persistent but can be resolved through the implementation of this technique. It certainly has its drawbacks, but with continued improvements, this technique could be effectively utilized in the agricultural sector.

The first and most obvious reason for its use is in areas where soil-related issues exist. Vertical farming eliminates the need for soil throughout the entire process of growing vegetables. This method can be adopted in places where soil is naturally absent or unsuitable for cultivation. This includes areas where deserts cover almost the entire landscape, leaving the local community with no possibility of growing food using traditional methods. It's also suitable for cold regions where changing seasons may not provide adequate sunlight or the necessary temperature for conventional food cultivation. It's worth mentioning that even places with available land may choose to use this technique when the land is unsuitable for traditional agriculture. Some lands become degraded over time and turn barren due to various factors. One factor is the gradual loss of nutrients in the soil, rendering it unsuitable for cultivation. Although this process is reversible by allowing the land to rest and regenerate, it is often economically unfeasible. Alternatively, various methods can be employed to address this issue, as there are numerous ways to handle it effectively. Some factors may be related to natural changes, with the most prevalent modern issue being land degradation due to the use of fertilizers and harmful agricultural practices, which leave the land infertile. Therefore, vertical farming has emerged at the right time to address land-related issues. It is also hoped that by using this method, some previously uninhabitable lands may be restored, as human activities will not take place in those areas [4, 5].

The second advantage is closely tied to the core of this technology, which is space efficiency. In the development of vertical farming, the approach was taken to maximize its potential by introducing vertical planting to save space while maintaining its original purpose. The advantage of vertical farming lies in its ability to make farming more convenient for the farmer, from planting multiple seeds to harvesting the produce in a smaller area, often easily accessible without additional equipment. It allows the farmer to manage the process efficiently and increase production without the need for larger areas.

Vertical farming is particularly well-suited for indoor cultivation. This is especially beneficial in areas with limited available land and challenging environmental conditions. It provides greater control over the entire cultivation process, which can be achieved through automation. Some processes, such as the delivery of essential nutrients to the roots of the vegetables, are already built into the system. Additional features like sensors for monitoring growth, health, readiness for harvest, and other parameters can be incorporated as well [6].

3 Drawbacks to the Approach

3.1 Usage of resources and structural properties

If one wishes to grow any type of food, they must have seeds and land. For thousands of years, people cultivated using natural resources without the need for additional equipment. Over time, various tools were developed, but these tools were primarily used to simplify the food growing process. In modern times, much has changed; now, tools are employed to replace some of the essential elements that were once necessary and can now be overlooked. However, there is a price to be paid. For example, when considering the use of vertical farming as an alternative to traditional methods, one must construct it. Building it means creating the entire system from the ground up. This process requires materials, commonly including plastic. Almost everything in vertical farming is constructed from plastic, except for some small components. While this technique indeed addresses critical issues, it also introduces others. The issue of plastic and its continuous production poses a threat to our environment. It is a well-known fact that plastic can now be found deep in the oceans and seas, as well as within the human body. Therefore, vertical farming lacks sustainable components that would be more eco-friendly and easier to construct. Complexity is another challenge associated with this technique. The overall structure may appear simple, but each cultivation method requires a different structural design, physical properties, and other important details. This means there is no single universal structure for cultivating any chosen food [7, 8].

3.2 Limit in diversity

Most of the time, there is one type of structure commonly used for growing vegetables that occupy less space. This allows farmers to have as many layers in the available space. However, crops that spread and require more space would render this technique inefficient. As a result, certain types of crops are not suitable for vertical farming. This doesn't mean they cannot be grown, but the technique is less effective with them and works best with others, especially those that take up less space and have lower demands.

3.3 The Need for Substitutes and Unforeseen Effects

Soilless growth of food means that there must be substitutes for healthy growth. Land that has not been aggressively utilized for modern farming contains all the necessary elements for various types of cultivation. However, vertical farming utilizes no soil and primarily relies on hydroponics, aquaponics, and aeroponics. This means that there must be a liquid version of some type of nutrients delivered to the crop's roots. Indeed, there is a nutrient-enriched substance mixed with water that circulates through the structure. One might wonder why this is a disadvantage. The answer lies in the fact that this nutrient mixture must be carefully selected for each type of crop, limiting biodiversity within the system as it's suitable only for one type. This also implies that the concentration and timing of nutrient supply must be automated, as an overdose or inaccurate calculation could lead to serious consequences. Another important concern is the lack of scientific evidence regarding how this type of cultivation might affect human health. The technology is new, and there have been no well-conducted studies on its impact on human health [9].

3.4 Additional equipment for indoor growing

Vertical farming may sound deceptively simple, but in reality, it is a complex structure that incorporates many different methods and is heavily reliant on construction. It comes in various forms; for example, those who use it as a hobby or for home agriculture likely employ simple structures and basic components. However, for mass production, it requires a significant initial investment in construction and maintenance compared to traditional methods. Therefore, before adopting this method, all necessary checkpoints must be thoroughly considered and addressed [10].

4 Future Applications and Improvements

The future may bring a revolutionary approach that encompasses all the necessary components to serve the agricultural sector comprehensively. However, as of now, vertical farming presents a promising future application. It will certainly be employed in the near future with some adjustments. These adjustments will primarily focus on enhancing the overall structure. Currently, there are different types of structures capable of accommodating lighter weights. With structural improvements, they could withstand heavier weights, thus expanding the potential for growing diverse vegetables. Additionally, the design might be reimaged to optimize its values. Another significant improvement will be in automation. Automation is the key factor in increasing efficiency. The entire process, from planting and monitoring to nutrient provision, collection, and other possible procedures, will become fully automated. While it's challenging to predict how the technique will evolve over time, analyzing the current trends suggests that the above-mentioned points will likely favor the survival and success of this technique.

5 Conclusion

In conclusion, the use and acceptance of vertical farming are gradually shifting towards the positive side. Many farmers are already practicing this technique and recognizing its benefits. Currently, it does have some limitations that set it apart from other methods. The future of vertical farming appears promising, and it is certainly a valuable technique, especially given the challenges we face as a society. This article aimed to introduce vertical farming to those unfamiliar with the technique and to illustrate to those who have heard about it that this farming practice has its own advantages and drawbacks.

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