VERTICAL FARMING

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The human population is expected to reach 9.7 billion by 2050, almost 70% of whom will live in cities. Not only does this population growth put tremendous pressure on the basic infrastructure that is necessary for modern society to function, but increasing urbanization also makes it more difficult to access the vital nutrients that we need to live. Agriculture, demanding increased production over the next three decades, to satisfy a want of consumers growing needs.

The idea was to grow food "vertically," using a hydroponic system. In usual farm it is very difficult to protect the plants from outside contaminants such as pollution and pests. On the vertical farms we can growing plants in stacks or towers. One tower can easily hold dozens of plants stacked on top of each other, all receiving nutrients and natural resources through the same system. With this method, farms take up 99% less soils, than in usually farms. It is making it easier to keep them in greenhouses that protect them from environmental factors. Vertical farming's main advantage of using technology is to increase yields with the less areas. Plants fed with artificial nutrients is a "closed loop" system that recycles inputs; and its effectiveness in minimizing water is an important part of why, that proponents consider vertical farming sustainable. Researches shows that compared to conventional agriculture, hydroponic farming can increase lettuce yields per area by about 11 times, while using 13 times less water. The «Eden Green» hydroponic technology is constantly growing to include more and more options. Now it is possible to growing more than 50 types of plants, including leafy greens, peppers, and microgreens. The most popular crops are Spinach, Butterhead lettuce, Kale, Romaine, Mint, Lavender, Basil. In a greenhouse covering area less of 1 hectare, you can grow 11-13 yeilds during year-round for fresh, healthy produce. This equates to about 2.7 million servings of leafy greens annually, the kind that are both incredibly tasty and nutrient dense too. And the same large-scale greenhouse can provide until 30 full time jobs.

And now we learned about smart greenhouses that grow herbs, berries, and vegetables all year round. The entire process is automated: computer vision sees how everything grows, neural networks understand whether everything is normal, and drones are used to control the crops. Artificial intelligence offers different optimization scenarios: to increase the light day, to change the temperature and mix up the nutrient solution a little. There is an electronic agronomist, it knows in advance how to mix nutrients.

The opponents of this system says that about economic viewpoint this system is very expensive to use. During the growing season, the sun shines on a vertical surface at an extreme angle such that much less light is available to crops than when they are planted on

flat land. Therefore, supplemental light would be required. Bruce Bugbee claimed that the power demands of vertical farming would be uncompetitive with traditional farms using only natural light. Environmental writer George Monbiot calculated that the cost of providing enough supplementary light to grow the grain for a single loaf would be about $15. An article in the Economist argued that "even though crops growing in a glass skyscraper will get some natural sunlight during the day, it won't be enough" and "the cost of powering artificial lights will make indoor farming prohibitively expensive". Moreover, researchers determined that if only solar panels were to be used to meet the energy consumption of a vertical farm, "the area of solar panels required would need to be a factor of twenty times greater than the arable area on a multi-level indoor farm", which will be hard to accomplish with larger vertical farms. A hydroponic farm growing lettuce in Arizona would require 15,000 kJ of energy per kilogram of lettuce produced. To put this amount of energy into perspective, a traditional outdoor lettuce farm in Arizona only requires 1100 kJ of energy per kilogram of lettuce grown.

As the book by Dr. Dickson Despommier "The Vertical Farm" proposes a controlled environment, heating and cooling costs will resemble those of any other multiple story building. Plumbing and elevator systems are necessary to distribute nutrients and water. In the northern continental United States, fossil fuel heating cost can be over $200,000 per hectare. Research conducted in 2015 compared the growth of lettuce in Arizona using conventional agricultural methods and a hydroponic farm. They determined that heating and cooling made up more than 80% of the energy consumption in the hydroponic farm, with the heating and cooling needing 7400 kJ per kilogram of lettuce produced. According to the same study, the total energy consumption of the hydroponic farm is 90,000 kJ per kilogram of lettuce. If the energy consumption is not addressed, vertical farms may be an unsustainable alternative to traditional agriculture.

References

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