

Vertical Farming System: High Production per Unit Area

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INTRODUCTION

Increased population pressure on agricultural land makes it necessary to maximize food output per cultivable area. In an effort to increase agricultural yield per square metre of land, attention is shifting more and more towards Vertical Farming System. Vertical farming has been proposed as an engineering solution to increase productivity per area by extending plant cultivation into the vertical dimension, thus enhancing land use efficiency for crop production (Eigenbrod and Gruda 2014).

In 1915, Gilbert Ellis Bailey coined the term “Vertical farming” and wrote a book titled “Vertical Farming”. In the early 1930s, William Frederick Gerick pioneered hydroponics at the University of California at Berkley.

In the 1980s, Ake Olsson, a Swedish ecological farmer, invented a spiral-shaped rail system for growing plants and suggested vertical farming as a means for producing vegetables in cities.

The modern concept of vertical farming was proposed in 1999 by Professor Dickson Despommier. His concept was to grow the food in urban areas itself utilizing less distance and saving the time in bringing the food produced in rural areas to the cities.

He intended in growing food within urban environments and thus have fresher foods available faster and at lower costs. Consequently, Vertical farming is conceptualized as cultivating and producing crops/ plants in vertically stacked layers and vertically inclined surfaces. Growing crops in vertical layers is known as "Vertical farming". It frequently uses soilless farming methods like- Hydroponics, Aquaponics, and Aeroponics as well as controlled-environment agriculture, which tries to optimize plant development.

Most vertical farms use enclosed structures similar to greenhouses that stack vertically, either directly above each other or staggered for better natural light exposure. If saving space is of utmost importance, hydroponic methods as a growing medium instead of soil allow for reduced weight and lower water requirements by up to 70%. The use of Aeroponics further reduces weight and water requirements. Most vertical farms are either hydroponic or Aeroponics and do not have run off, which would make the potted plants heavier.

Techniques of Vertical Farming

1. Hydroponics

Hydroponics refers to the process of growing plants without the need of soil. In hydroponic systems, plant roots are immersed in liquid solutions containing trace elements including iron, chlorine, manganese, boron, zinc, copper, and molybdenum as well as macronutrients like nitrogen, phosphorous, sulphur, potassium, calcium, and magnesium. In addition, soil replacements like gravel, sand, and sawdust are employed to support the roots because they are inert (chemically inactive) mediums.

2. Aquaponics

Aquaponics is a symbiotic system of cultivation environment in which aquatic animals like snails, fishes, etc. are grown in reservoirs with a combination of hydroponics in which plants are grown in water. While the fish provide fertilizer for the plants, the plant roots filter the water for the fish.

3. Aeroponics

The method known as Aeroponics involves growing plants in an air or mist without soil or spraying the roots with hydroponic solutions that are suspended in the air. It doesn't use a medium made of soil or aggregate. A nutrient-dense fluid is sprayed on the plant roots at regular intervals while the plant roots are suspended in a dark cage in an aeroponic system.

Benefits of Vertical Farming

There are many advantages to vertical farming, including maximum production with no negative environmental impact and much less acreage needed. It will get harder to maintain food production using conventional techniques as resources grow more scarce.

Increased Production around the Year

Additionally, vertical farming delivers enhanced annual productivity and reliable year-round production. Some fruits and vegetables are no longer solely available during specific seasons. Instead, with little reliance on weather or environment, vertical farms may grow a wide variety of crops all year round.

Required Less Space and Water

The utilization of 99 percent less land and 98 percent less water is possible for farmers using vertical farming techniques. By rolling or perpetually harvesting their crops all year long, they may create agricultural yields that are 240 times greater than those of conventional farms. The sun, not LED lights, powers all of our products, removing the need for fossil fuels or other less-than-ideal energy sources to grow these crops.

Food Desert Solution

The growing issue of food deserts, where people lack access to fresh meals like fruits and vegetables, can also be solved by vertical farms. Where food deserts once existed, vertical farming has already begun to create food deserts since it can be built with a minimum environmental impact and even integrated into existing structures and rooftops. In places where there were previously only unhealthy options, healthy food is now available. It can also generate economical and wholesome food for low-income families because it doesn't need a drawn-out transportation and warehousing process.

Efficiency

Conventional farms require too much land and water, while vertical farming requires a fraction of it with more yield per acre. Vertical farming uses a small fraction of the

land and water needed for conventional farming while producing more per acre. Vertical farming also offers the advantage of year-round agricultural production. Due to their distinct plots and independent lands, even more than one crop can be gathered at once.

Weather resistant

Natural calamities including floods, droughts, and wildfires as well as unpredictable weather patterns are a threat to traditional farming. Such factors are eliminated in a controlled vertical farming setting, making the supply chain process less vulnerable to disturbance.

Environmental Conservation

Due of the ability to avoid the deforestation that comes with regular farming, vertical farming aids in resource conservation. When food is grown indoors, conventional farm machinery ploughing, planting, and harvesting are reduced or eliminated, conserving the soil and lowering emissions.

Limitations of Vertical Farming

Needed Experts

An expert is usually required to set up a vertical farm because it is a rather sophisticated structure. Since they are mostly hydroponic, different factors must be taken into account than in a traditional farm.

Expensive investment

The upfront expenditure is substantial due to the high complexity of developing a commercial facility. As a result, when planning the farm, you must be careful about your choices. It is challenging to change a concept once it has been chosen after the facility has been built, and doing so could result in an unforeseen financial burden.

Less Pollination

Vertical farming is performed in a controlled, indoor environment. While this comes with many advantages, it also hinders the entry or advent of insects. That means the process of pollination is almost entirely hindered. Vertical farming is performed in a

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CONCLUSION

For those who live in cities, vertical gardening is the greatest option. It can supply food in a sustainable manner, enhancing global food security and addressing issues with environmental degradation. No harvest would be ruined by extreme weather events. It has the advantage of making it simple to reduce water use for cooling and heating. It improves food safety, human wellbeing, and poverty reduction. The efficiency of vertical gardening is influenced by factors such as food demand and supply, urban population and density, technological advancement, availability of water and energy, and weather.

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