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Vertical Farming

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Abstract

The aerial farm is a revolutionary concept that has transformed around the world. Imagine a world in which each city has its own local food supply, where water or particulate light are lost in the safest way possible. Intelligent farming leads enormously to 21st century food production. This is because the control of the climate and water is directly affecting plant growth. Vertical agriculture is known as a new instrument for the feeding of large world populations by 2050. It specializes of constructing a farm close to the people it supports by offering cheaper and sustainable crops free of disease together with the help of scarce natural resources. The idea of vertical farming has been a promising future with recent advances in greenhouse technology such as hydroponics, aquaponics and aeroponics. Such high-tech systems are a paradigm shift in agriculture and food processing and provide appropriate and effective urban farming methods by reducing maintenance and yield. After analyzing these technologies and prototypes of projects, researchers find that these efforts can plant seeds for vertical farming.

Keywords: Efficient Food Production, Food Sustainability, Smart Farming, Sustainability, World-Changing Innovation

Introduction

The use of less water and no soil is a form of vertical farming, which means planting in vertically stacked layers or in engineered systems (such as skyscrapers or old warehouses). Vertical farming is a modern idea that uses (CEA) controlled environment agriculture technology and indoor farming techniques where it is possible to control all environmental factors such as artificial light control, humidity, temperature and also organic fortification that grows crops to improve their nutritional value[1], [2]. Vertical agriculture is proactively aimed at ensuring the prosperity of our communities by providing food security to the growing urban population in the world. Essentially, it's a simple concept; instead of farming out. There are three types of vertical farming in the literature on the subject. The first method is to build large buildings with multiple levels of beds, frequently relying on artificial lighting[3], [4]. This often modest urban farm has appeared all over the world. Several towns have brought this pattern into effect in new or old structures, like warehouses used by farmers for agricultural activities. The second type of vertical cultivation takes place on the roofs of old and new houses, in commercial and residential buildings and in restaurants and supermarkets. The third vertical farm is the multi-story revolutionary structure[5], [6]. Researchers has seen a growing number of serious innovative ideas of this kind in the last decade. Nonetheless, none has been developed, but it must be remembered that the connection between these three styles would undoubtedly open the way for the skyscraper

farm to the success of small-scale vertical farm projects and to the maturation of its technology[7], [8]. Theoretically, the vertical farm is able to produce fish, fruits, vegetables and poultry using innovative greenhouse techniques such as hydroponics and aeroponics. Vertical agriculture is planned more than traditional agricultural practices to encourage sustainable agriculture, which applies to large-scale, open farming involving schemes involving heavy irrigation, intensive deforestation and the overuse of fertilizers, herbicides and pesticides[9], [10].

1. Vertical Farming Need:

One of the major challenges is the increasing food demand as a result of the growing population and the ever declining arable soil. The high yield strategies that sustain our enormous population are distinguished by the unsustainable use of our scarce fresh water, fossil fuels and earth reserves. Vertical agriculture is an industrial farming of crops within a town or urban centre structure where floors are intended to support a variety of crops. Such heights will serve as potential land for farming, and can be developed by countries with little or no arable land that are currently unable to develop into top-class food producers. For today's urban needs and future generations, vertical agriculture provides an alternative means of sustainable food production. Production of food is only the beginning. Such vertical farms will recover grey and black water and will generate energy from plant waste incineration (thinking plasma arc gasification) to reduce waste to its constituent molasses. They are also responsible for collecting water from dehumidification. Each urban center has one or more miles to every produce.

2. Potential and Scope:

- Lower degradation and use of land: reduced erosion and fewer floods.
- Development is to be used on unwanted or vacant properties.
- Crop protection from harsh weather conditions such as floods, drought and snow may take place.
- Vehicular transport reduction is easy to consume as the developed crops.
- Less CO2 emissions and waste due to reduced reliance on coal burning product.
- Wellness as a whole and industrial waste was channeled directly into farm buildings.
- More efficient is the use of water.

3. Vertical Farming Working*:*

There are four critical areas in which the vertical agriculture works:

- Growing medium
- Physical layout
- Sustainability features
- Lighting

Firstly, the primary objective of vertical cultivation is to produce more food per meter which ensures that crops are stacked vertically to cultivate. Furthermore, natural and artificial lights

are mixed beautifully to ensure a perfect amount of light in the room. Lighting quality is increased by technologies such as revolving beds. Thirdly, instead of using the soil, hydroponics (the plant roots are bathed in a nutrient bath) or aeroponics (plant root spray) are used for the use of Oraquaponic growing mediums. Coconut husks or peat moss are very popular in a vertical farming with a comparable amount of non-soil content. Finally, the vertical agriculture process uses specific performance properties to offset the energy costs of agriculture. Vertical agriculture actually uses 95% less water than conventional agriculture.

4. Hydroponics:

Hydroponics is a soilless plant propagation system. The plant favors inert crops like cocopeat which uses a nutrient-rich water solution rather than its root, which uses 70% less water than typical crops. Instead the plant uses an inert crop medium such as cocopeat. Hydroponic structures may be as basic as a glass of water filled with gravel and fertilizer-containing water or complicated like a large grass structure containing cocopeat-filled beds of clay pellets / troughs regularly filled with a nutrient solution. Nutrient Film (NFT) is a hydroponic cultivation that has been introduced these days by many trade farmers.

Hydroponics can be performed in three different ways:

- It can be embraced in commercial agriculture by progressive farmers.
- People should embrace it as a hobby.
- Can be most advantageous for urban metro agriculture.

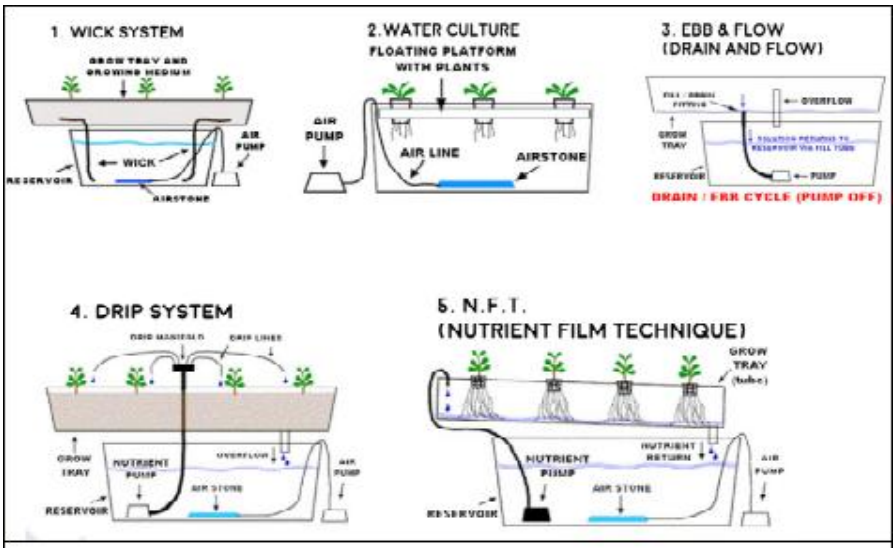

Figure 1: Types of System

The attributes and advantages of NFT include:

- Water is in the system remains and lower consumption of water can be stored.
- No soil is needed.
- The levels of nutrition can be controlled.

- Produces attractive and highly nutritious crops.
- Stable higher yields between harvests and shorter time.
- Easier collection and distribution of direct sales income.
- Lower insect and disease contamination are more easily removed than in soil.

5. Aeroponics:

Aeroponics is a plant propagation method without the addition of soil or an aggregate substrate in the air or dung environment. The fundamental principle of an aeroponic planting is to grow plants hanging from the slurry roots and the lower stem with a sprayed, nuclear-rich solution of water Plants in a real aeroponic system have 100% exposure to concentrations of CO2 from 450 ppm to 780 ppm. A high crop production uses less water than hydroponics which needs 70% less water.

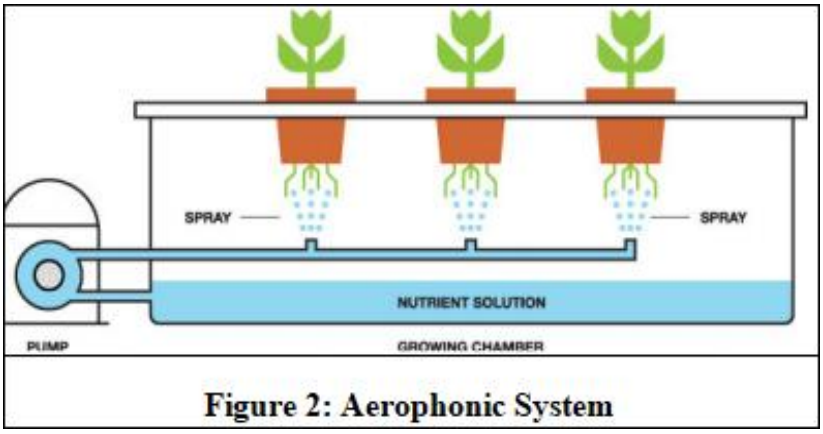

Figure 2: Aerophonic System

6. Aquaponics:

Aquaponics is a recirculation system that combines aquaculture (fish farming) and hydroponics to build an effective closed system for plants that have been grown in water without soil. The two are used in the symbiotic mix of Aquaponics where plants are fed the discharge or waste of aquatic animals. The crops clean up the water that falls to the fish in exchange. Microbes play an important role in plant nutrition along with fish and their waste. Such beneficial bacteria accumulate between the roots of the plant and turn solid and fish waste into products that can be used for the growing of plants. The consequence is a good partnership between gardening and aquaculture.

6.1. System Requirements:

A pH of equilibrium is good between 6.8 and 7.2, plants, bacteria and fish are present in the water and each has a different pH value. The pH is acidic because of fish waste and aquaponic pH adjusters must be used. Sometimes it is important to also take care of the consistency of the water when operating on pH.

- No fertilizers or pesticides are being used.
- Fish meal is the only supply in the system.

- The energy provides water pumps and heaters.

6.2. Aquaponics can Grow Fish and Other Aquatic Animals:

Fish feeding the plants are freshwater fish, most common because of their ability for a greater variety of conditions and because they are growing rapidly in this aquaculture. Trout may also be used especially at lower water temperatures. Fish are the ones that feeding the plants.

6.3. System Parts:

- *Rearing Tank*: the fish raising and feeding tank;
- *Bio Filter:* The bacteria nitrification grows and converts ammonia into a plant functional nitrate.
- *Settling Basin:* a facility for the collection and removal of fine particles in discarded foods and biofilms;
- *Hydroponics Subsystem:* the part of the network in which plants are cultivated by consuming water excess nutrients;
- *Sump:* The lowest point in the network to which the water is pumped out into and discharged into the rising reservoirs.

7. Advantages and Disadvantages:

7.1. Advantages of Vertical Farming:

- *Preparation for the future:* about 80% of the world's people are projected to live in urban areas by 2050, and the increasing demand for food will rise. The productive use of vertical agriculture may perhaps be critical in planning for a challenge of this kind.
- *Improved crop production throughout the year:* vertical farming allows us to produce additional cultivations from the same square images of the harvest. In addition, an indoor area of 1 acre provides an outdoor potential of at least 4-6 hectares.
- *Less cultivated water:* vertical farming enables us to grow cultures with 70-95 less water than the usual cultivation requirements.
- *Unfavorable weather conditions do not impact crops in a field:* natural disasters, including, torrential rainfall, cyclones, storms or extreme drought, could be detrimental to the crop area. Vertical indoor farms experience less the bad weather and provide greater certainty of crop production throughout the year.
- *A rise in organic crop production:* when crops are grown without the use of chemical pesticides in a regulated indoor environment, vertical farming allows pesticide-free and organic cultivations to be cultivated.
- *Friendly for humans and the environment:* vertical indoor farming can significantly reduce environmental risks in conventional agriculture.
- Farmers are not subject to hazards associated with heavy farming facilities, such as malaria, toxic chemicals etc.

7.2. Limitations of Vertical Farming:

- *No Economics:* The financial viability of this new method of farming remains uncertain. The costs of building sky scraps for agriculture along with other costs including

electricity, ventilation and jobs can be more than the advantages that can be gained from vertical agriculture's production. The building cost will hit over 100 million dollars for a 60 hectare vertical farm.

- *Pollination difficulties:* In a controlled environment vertical farming takes place without insects. As a result, the pollination process must be manually carried out, which is difficult and expensive to operate.
- *Labor Costs:* In vertical agriculture the cost of labor can be extremely high as highly skilled workers are required. The hourly costs of employees can therefore be much higher than in general for agriculture. Yet vertical cultivation technology may require extensive preparation that raises labor costs.
- *Fewer jobs:* The need of fewer employees can result from automation in vertical farms. Manual pollination in vertical farms could become one of the work-intensive features.
- *Lower Worker Productivity:* the vertical architecture of a farm will provide the employees with a task to enter each sheet. It takes time and effort to reach top layer reducing the overall productivity of workers.
- *Too much technological dependence:* all vertical agriculture is extremely dependent on different lighting, temperature maintenance and humidity technologies. The loss of energy for just one day can prove very expensive for a vertical farm.

8. What can People Grow in Vertical Farm:

Spinach, Kales, Oregano, Tomatoes, Parsley, Strawberries, Radish, Thyme, Ice berg, Chard &collard Greens, Basil (lemon, sweet, cinnamon, etc.), Chives and mint

Conclusion

Technologies of vertical farming remain relatively new. Industries still have to produce crops on a scale to economically satisfy that demand for food. The visionaries of this modern farming methodology work for a networked agriculture system that looks for guidance to the open source software revolution. In addition, this module can be remotely controlled by the use of mobile application devices by coordinating image processing and mobile applications. The viability of the vertical farm would rely not only on technological innovation but also local conditions, including consumer demand for certain goods, labor supply and agricultural conditions. Also important factors are an effective organizational structure and strong leadership. The critical components for organizations that venture into new businesses like vertical agriculture are innovation, management and inventiveness. Competition is tough in a globalized world, but the first success could achieve a competitive edge. Some wonder how much vertical agriculture can be included to create a balanced climate, but landscape agriculture must be maintained as long as they are accommodated with this new technique. “Vertical farming needs to be heard, learnt and done”.

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