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“Vertical Farming / Hydroponics”

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Vertical farming is an advanced technology and intensive farming method this can exponentially increase production. The vertical farming is coming up to face the many challenges are water scarcity, climate change, labour scarcity and urbanization leading to reduction in arable land. Vertical farming provides an employment opportunity, to support the local economy and healthy food in neighborhoods where fresh produce is scarce. Vertical Farming can be beneficial for increasing in food production, maintaining the high-quality products, safety and also contributing to sustainable urban farming. The main advantages of vertical framing are beneficial for environmentally, socially and economically. Vertical farms can also provide solutions for increasing food security worldwide. This study is a critical review from related published papers from relevant journals and scientific online databases. The crops are grown by using various growing in vertical farming are perlite, coco-peat, vermiculite etc. to enable fast growing and high yield. The vegetables are suited for best under this vertical farming, as these are short duration and provides high net returns.

I. INTRODUCTION

General: Vertical farming is the practice of growing produce in vertically stacked layers. The practice can use soil, hydroponic or aeroponic growing methods. Vertical farms attempt to produce food in challenging environments, like where arable land is rare or unavailable. The method helps mountainside towns, deserts and cities grow different types of fruits and vegetables by using skyscraper-like designs and precision agriculture methods. Most vertical farms use enclosed structures similar to greenhouses that stack vertically, either directly above each other or staggered for better natural light exposure.

1.1 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 aeroponic and do not have run off, which would make the potted plants heavier. Vertical farming is the practice of growing crops in vertically stacked layers. It often incorporates controlled-environment agriculture, which aims to optimize plant growth, and soilless farming techniques such as hydroponics, aquaponics, and aeroponics. Some common choices of structures to house vertical farming systems include buildings, shipping containers, tunnels, and abandoned mine shafts. As of 2020, there is the equivalent of about 30 ha (74 acres) of operational vertical farmland in the world. Vertical farming is much more than just stacking plants and hoping for the best. The practice requires artificial temperature, light, water, and humidity control. If a delicate balance is not maintained, it's possible to lose an entire crop the way a traditional farm might in the event of a drought or flood.

1.2 WHAT IS VERTICAL FARMING/ HYDROPONICS:

- i. Hydroponic vertical farming is growing plants on a vertically inclined surface with the help of a specific nutrient solution. Hydroponic systems that allow growing of plants in a vertical fashion are known as vertical hydroponics. Vertical hydroponics works by using conventional hydroponic techniques in a vertical, gravity fed system. The nutrient-rich water is fed from the top and collected at the bottom.
- ii. In a vertical farming system, multiple layers of growing trays are arranged in stacks. In each of these, plants are grown in nutrient-rich water instead of soil. Also called a vertical hydroponic system, this grow automation system is an excellent option to get fresh produce in large volumes even when space and other resources are limited, especially in urban cities.
- iii. Hydroponics is a soilless farming technology that evolved quite a lot in the past decade, especially in India. Plants grow in a controlled environment without soil with the help of different substrates (coco peat, hydroton, perlite, clay balls) and specific hydroponics nutrients. It is a wonderful technology in terms of water conservation as it requires almost 90% less water than that required for traditional flat farming.

1.3 OBJECTIVES

Vertical farming is the urban farming of fruits, vegetables, and grains, inside a building in a city or urban centre, in which floors are designed to accommodate certain crops. The objective of this dissertation was to investigate the feasibility and plausibility of the vertical farming concept in three specific and interrelated research domains.

- i. The first research question was to investigate whether enough energy can be generated onsite to meet the needs of the building.
- ii. The second research question was to investigate the carbon footprint of produce grown vertically and compare that to produce grown conventionally (greenhouse and outdoors).
- iii. The final research question was to investigate how relevant stakeholders perceive the concept of vertical farming and what they believe are current barriers and opportunities towards uptake of the technology. The purpose of this investigation was to determine ways to supply food to cities in an energy efficient and sustainable manner from both a quantitative and qualitative

1.4 ADVANTAGES

- i. Uses significantly less water.
- ii. Increased, and year round crop production.
- iii. Weather doesn't affect the crop.
- iv. Significantly less fertilizer, if any is used at all. No runoff.
- v. More organic crops, no disturbance to wildlife.
- vi. Significantly less land use.

1.5 DISADVANTAGES

- i. Difficult and costly to implement pollination.
- ii. Involves high labour costs.
- iii. Relies heavily on technology, one day of lost power would be devastating.
- iv. High energy consumption.
- v. High cost of LED lighting system.
- vi. Skilled labor requirement.

1.6 TYPES OF VERTICAL FARMING

i. Hydroponics

- Hydroponics is the method of growing plants without the involvement of soil. Here, plant roots are submerged in magnesium, nitrogen, potassium calcium etc. These solutions support roots, improving chances of higher yield and reducing dependence on water.
- Studies have shown that there have been 11 times yield compared to conventional farms at a cost of 13 times less water. Thus hydroponics is the most widely used method in Vertical Farming.
- Also known as soil-less farming, is a Greek word made of two separate words: hydro, water, and ponics, 'to labor, toil.' This technique dates back between 605-562 BC, when the first documented vertical garden was made and came to know as the 'Hanging garden of Babylon.' However, the first commercial vertical farm was opened in Singapore, constructed by Sky Greens Farms, a robust model of hydroponics and aquaponics farm with its own ecosystem of fish, shrimp, and plants.



Fig no :1 Hydroponics

ii. Aeroponics

- Aeroponics is a technology also known as air water cultivation system that allows the crop to grow in the air instead of soil or a growing medium inside a closed environment.
- The significant difference between aeroponics and hydroponics is how nutrients are delivered to the plants.
- The aeroponics system is a closed container. The plant roots are then misted with a mixture of water and nutrients adjusted to the plant's requirements.
- However, the drawbacks are managing crops with big roots and a continuous power supply to keep the misting sprays working, making it a fairly complex procedure.



Fig no: 2 Aeroponics

iii. Aquaponics

- Aquaponics is the process of using water and fish waste to grow plants, while at the same time using plants to purify water for the fish.
- It is a mix between hydroponics, which is growing plants without soil, and aquaculture, which is growing fish.

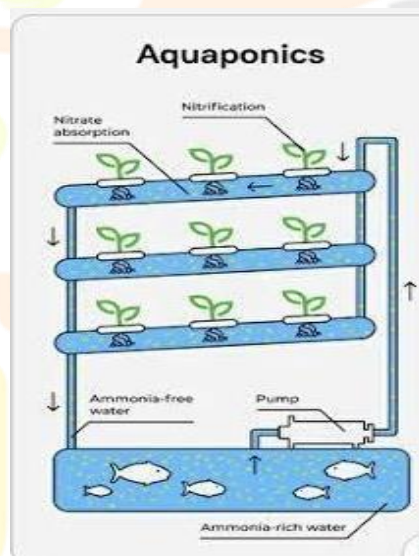


Fig no:3 Aquaponics

1.7 MATERIAL REQUIRED FOR PROJECT :-

- Angle
- Iron pipe
- Pvc pipe

- Motor
 - Water tank
 - Plastic tube
 - Paints
 - Wires.
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- Artificial sunlight
 - Net Pots
 - Cocopeat
 - Seeds
 - Nutrients

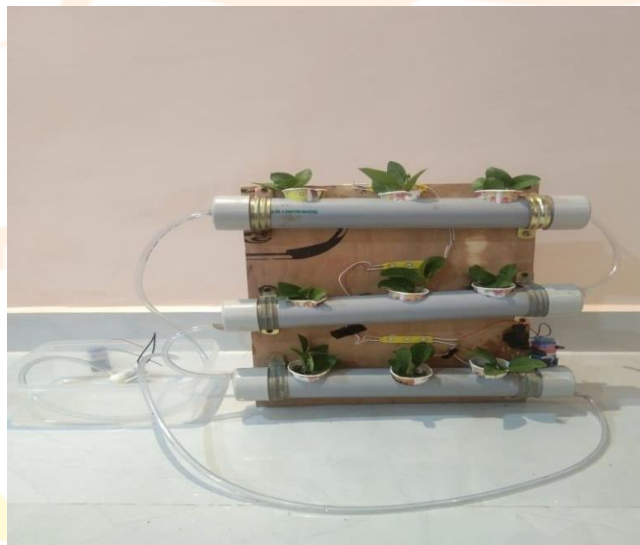


Fig no:4 Model

1.8 FUTURE SCOPE

- Reduction in vehicular transport is also foreseen there will be less demand for delivery trucks, garbage trucks and other utilities.
- Overall wellness because city wastes will be channelled directly into the farm by using a recycling system, hence, less bacteria can find its way in the environment and the atmosphere. Abandoned or unused properties will be used productively.
- Water can be used more efficiently in a vertical farm. The greywater from office etc. can be used efficiently. The layers of

atmosphere can be used effectively in vertical build ups.

- Less CO₂ emissions and pollution by decreasing reliance on coal- burning power plants and transportation, and implementing renewable-sources of energy Crops will be protected from harsh weather conditions and disturbances like typhoons, hurricanes, floods, droughts, snow and the likes.
- Food production as well as food transport will not be affected. Crops will be consumed immediately upon harvest since there is no need to transport them to far-off places. Spoilage will also be lessened

1.9 CONCLUSION

- Vertical farms in urban areas are a relatively new phenomenon,
- But interest in this approach is growing, and the number of vertical farms in the United States is expanding every year. There are several variations of vertical farms being tested throughout the world, and new innovations and technology will likely increase the energy efficiency and profit margins of these farms in the future.
- In the near term, most vertical farms will focus on high-return and short-rotation crops such as salad greens, with nearby restaurants often buying all of the production.
- In vertical farming, there is less use of water and there is also less waste . Also because crops are grown in a controlled environment they are safe from pests and diseases.
- Water is used 70-95% less in vertical farming than in traditional farming.

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