



Vertical Farming: The Advance Technology

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Abstract: Emerging problems such as food security, urbanization, agricultural shortages, carbon emissions from increased food production focus on the need for vertical farming. In the future, more and more of the world's population will be able to self-feed with the help of planting language for vertical farming, eco-friendly, energy saving and other farming methods. Vertical farming is that combines home and farm designs in the high-rise city, using a new farming method to grow vegetables vertically.

Cities with low prices and expensive land must produce enough food to feed their citizens to avoid accidents, pollution and rising food prices. These technologies have revolutionized agriculture and food production and are ideal for urban farming as they reduce maintenance and increase yields. This technology, along with project prototypes, could lead to vertical farming becoming a reality. The ideas provided by can serve as guidelines for the development and planning of urban vertical farming innovations and the use of agroindustry. This article reviews the benefits, advantages, and disadvantages of using a vertical farm. Lack of skills, economic capacity, standards and regulations are the main obstacles to vertical farming. Designing a low-cost, easy-to-operate system that requires minimal labour and minimizes overall installation and operating costs is critical to the success of the vertical farming process. It also helps reduce poverty, increase food security, and improve environmental stability and human health.

Keywords: aeroponics, hydroponics, pandemic, urbanization, vertical farming, food production.

INTRODUCTION

Rapid urbanization, natural disasters, global warming and uncontrolled use of chemicals and pesticides have affected soil fertility. In addition, land productivity has decreased, soil fertility has decreased and per capita land availability has decreased. Climate change, high temperatures, frequent droughts and unpredictable weather are just some of the challenges facing the watershed in the basin. Excessive use of water for irrigation, poor water management and declining groundwater levels are just some of the threats to water in the basin, with an estimated population of 8.9 billion, the world must produce 50% more food and need more land that cannot be obtained.

Traditional agricultural production methods face serious threats from these challenges, making food production a real challenge today. Land-based agriculture must be complemented by more efficient and environmentally friendly modern agriculture. Land degradation, depleted soil nutrient reserves, limited water for irrigation, and climate change are factors to consider when implementing these new agricultural practices. Hydroponic farming may be one way to tackle these challenges today. As an alternative to tillage, vertical farming methods can be used as additional methods to help solve existing problems such as fertile soil and water shortages. Hydroponics, also known as hydroponics, is a special technique used to grow plants without soil. The crop growing process is not unusual as they follow the principles of nature it has established itself as a model of life. Other methods of growing soilless crops are aeroponics, aquaponics, roof farming etc. Different crops such as wheat, rice, tubers, forage corn and many other crops such as spinach, okra, cucumber, onion, carrot and tomato can be successfully grown in vertical farming, showing greater benefits and good nutrition. Hydroponic systems for vertical farming are best suited for forage production in intensive cultivation of corn forage.

Food is ready in 7-8 days and all foods are loved by animals. In addition, vertical farming crops are about 10 times larger than conventional crops and save about 70-95% of water. Plants are grown hydroponically using artificial growth media and solutions designed to provide the optimum amount of nutrients that plants need to thrive and grow. This can be seen as the art of water management, which infuses plants with essential nutrients and sends them to dehydration in a timely manner, yielding high efficiency while using less water and more work than expected.

Hydroponic plants are healthier and more nutritious than ground plants. One of the key advantages of hydroponic farming over conventional farming is that it allows control of all crop nutrients, providing better nutrient management and improved water management. For the above reasons, hydroponics is considered the best farming method in almost every country in the world. Many developing countries, especially the United States and China, have conducted hydroponic research with the aim of increasing crop yields and overcoming their limitations. Many crops, including lettuce, cucumbers and tomatoes, have been tested in hydroponic farming in developing countries. This is still a young method; however, extensive research is needed before it can



be used in crop production in developing countries. The hydroponic equipment market in India is growing due to the increasing population of the country. Extensive research on the evidence and different mechanical properties makes this impossible. Over the past few years, farmland in the Kashmir Valley has been gradually converted to non-agricultural uses. In the last five years alone, it has been reported that more than 20% of countries have switched to commercial or residential use. Jammu and Kashmir's GDP UT fell from 28% in 2004-05 to 16.05% in 2017-18 due to reduction in farmland.

The biggest challenge for the farming community in the region in the future is, among other things, the use of scarce arable land and water to sustain agriculture salinity, cultivation. The region was affected, to say the least. The effects are negative. As farmers quickly use pesticides and other agricultural chemicals. Since no chemicals are used in vertical farming, we can grow pesticide-free and organic products in a comfortable indoor environment. The dangers of farming can be greatly reduced by using vertical farming methods at home instead of traditional farming methods at home.

Our agricultural researchers, universities and research institutes must turn to vertical farming, our only hope. According to different crops and climate, hydroponic production can bring many benefits. The answer to these questions is vertical farming. VF evolved into a project combining home and farm designs into one high-rise building. VF is a planting system from vertical structures to skyscrapers where soil, plants, animals, fungi and other living things are grown for food, oil, fiber. It has been used in many countries. Currently, of these farms grow and produce a variety of crops, mostly in the city. There are many posts about urban farming and VF. However, there is little information about VF technology. So far, there is no accurate definition of VF. This study attempts to examine the processes and procedures used in the VF program worldwide.

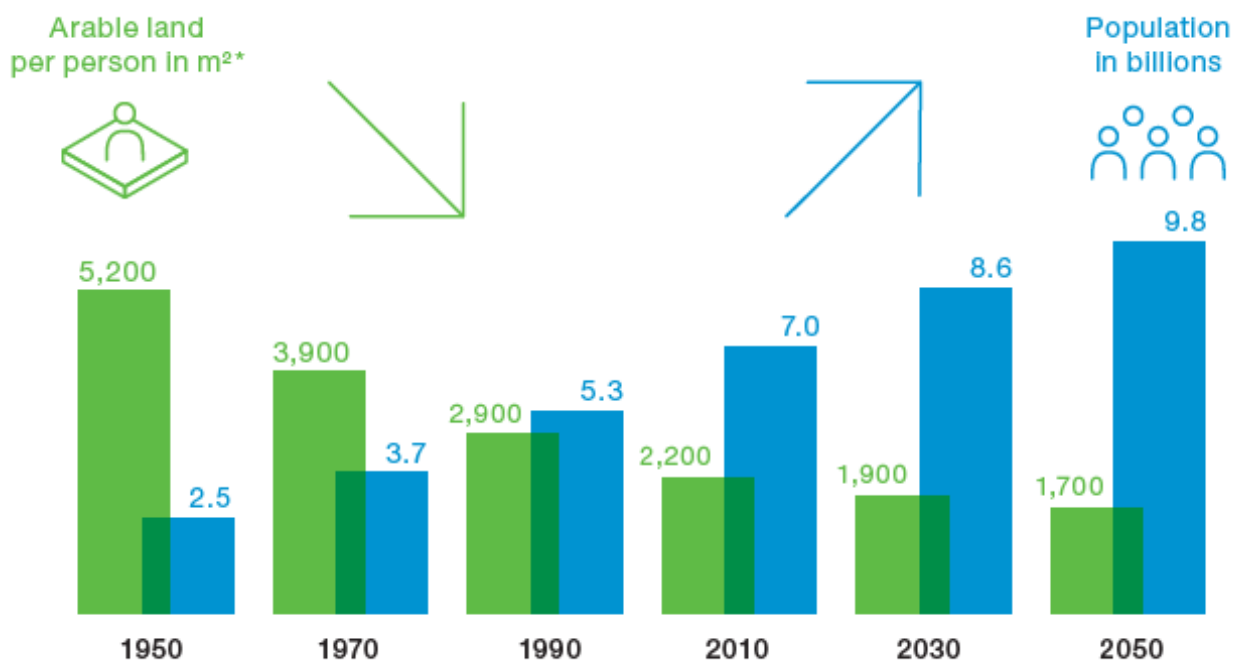


Fig. 1: Increasing global population and decreasing cultivable arable land of World

Concept of Vertical Farm

Vertical farming involves growing crops inside buildings such as skyscrapers or old warehouses instead of soil, which saves water and eliminates the need for land. No amount of weather or other natural conditions can prevent food from coming from vertical farms. Many plant species can grow well year-round if planted in a controlled environment with constant care and environmental control, such as light, humidity, and temperature (Vertical Farming: Feeding the 21st Century World). Vertical farming strategies aim to increase productivity. Heat, light, humidity, and gas can control indoor food and drug production. Thanks to the use of a closed system, the drug does not enter the environment. He coined the term "vertical farming" and in 1915 wrote a book on the subject called Vertical Farming, which is still in print. Dickson Despommier introduced the concept of modern vertical farming in 1999. The term "father of vertical farming" refers to his pioneering work in this field. Growing food vertically bears some similarities to the use of metal reflectors and fluorescent lights in greenhouses. Now farmers face many problems. Every year, an average of 220 million people are at risk of violence, including the most vulnerable. In developing countries, about 20,000 people die each year from pesticides.



Rapid urbanization and industrialization have reduced farmland, but also reduce the benefits of traditional agriculture, which has a negative impact on the environment. Enough food-growing technologies must be developed to feed the world's growing population. Sustainable production and protection of soil and water resources can be achieved through the use of sustainable development media. Hydroponic farming can be successfully introduced and can be considered as an alternative to growing healthy crops, crops or vegetables in the current situation. Three distinct types of vertical farming have been identified in the literature on the subject food safety. This is where vertical farming comes into play. In theory, it's a simple idea: grow your own food instead of relying on imports.

These structures are usually high, with many layers of growing beds, often covered with lighting. Farm cities of all shapes and sizes are popping up all over the world. Old and new buildings, as well as converted farms, follow the model in many cities. This type of vertical farming takes place on the roofs of old and new buildings, as well as commercial and residential buildings, as well as restaurants and supermarkets. This visionary multi-storey building is the third type of vertical farm. In the last ten years, many similar agreements and proposals have been made. However, such a model has not been developed. It is important to keep in mind three types of vertical farming; The success of small vertical farms and the development of their technologies could lead to skyscraper farming. Environmentalists, urban farmers, architects, agronomists and health professionals are joining this small change to figure out what to do, how to survive food shortages and the urban future.

The concept of vertical farming brings together various experts in the fields of robotics, aeroponics, aquaponics and hydroponics. The concept of vertical farming is supported by non-profit organizations working to improve the environment and the local economy. Likewise, a nonprofit focusing on cooking for local produce supports the idea. These efforts are also funded by the government, which is looking for ways to improve local food security. Countries from all over the world met to discuss vertical farming. They reaffirmed this idea as an essential part of their city's long-term viability.

Vertical farming is not an entirely new concept by any stretch of the imagination. An example of this can be found in the Hanging Gardens of Babylon, one of Philo's Seven Wonders, built around 600 BC. Gilbert Ellis Bailey first used the term "vertical farming" in his 1915 book "Vertical Farming". He believes a vertical hydroponic management environment will provide economic and environmental benefits. At the turn of the century, Dickson Despommier, an American scientist and health expert, repeatedly introduced the concept of vertical farming. In his summary, he called it "a major commercial plant of flora and fauna in skyscrapers." Fish, poultry, fruit and vegetables can be grown using aquaculture and aeroponics, two of the most advanced greenhouse systems.

Unlike conventional agriculture, which is defined as large-scale open-air farming with large-scale irrigation, intensive farming, and systems such as lots of fertilizers, pesticides, and herbicides, vertical plantations encourage agriculture in a controlled environment. On the other hand, indoor farming can provide a better environment for growing food. Because indoor farming is year-round and weather independent, it can provide more profitable and long-term income. Reducing travel between rural farms and local businesses through indoor farming can reduce travel costs and greenhouse gas emissions. Additionally, urban areas can benefit from creating much-needed "green" jobs through vertical farming. In addition, vertical farms can help solve land shortages in agriculture.

General Structure of Vertical Farming

Vertical farms vary from city to city. More general instructions on the construction, various designs and details of the as VF are described in the next section. This high-rise building, which instantly caters to people, was designed with the following features: Vertical farm scale for crop production and aquaculture only. In addition, some floors of the same distribution are used to control the environment, while the other underground building is used to store waste.

In addition, a floor has been placed for display and germination for large care trays. A layer is used to pack and make vegetables or fish. Another floor, basement number, is used to sell goods. In the middle of the building is a wide elevator, big enough to stop a forklift. This helps to send the crop to another floors.



Fig 2: Interior view of Vertical Farming

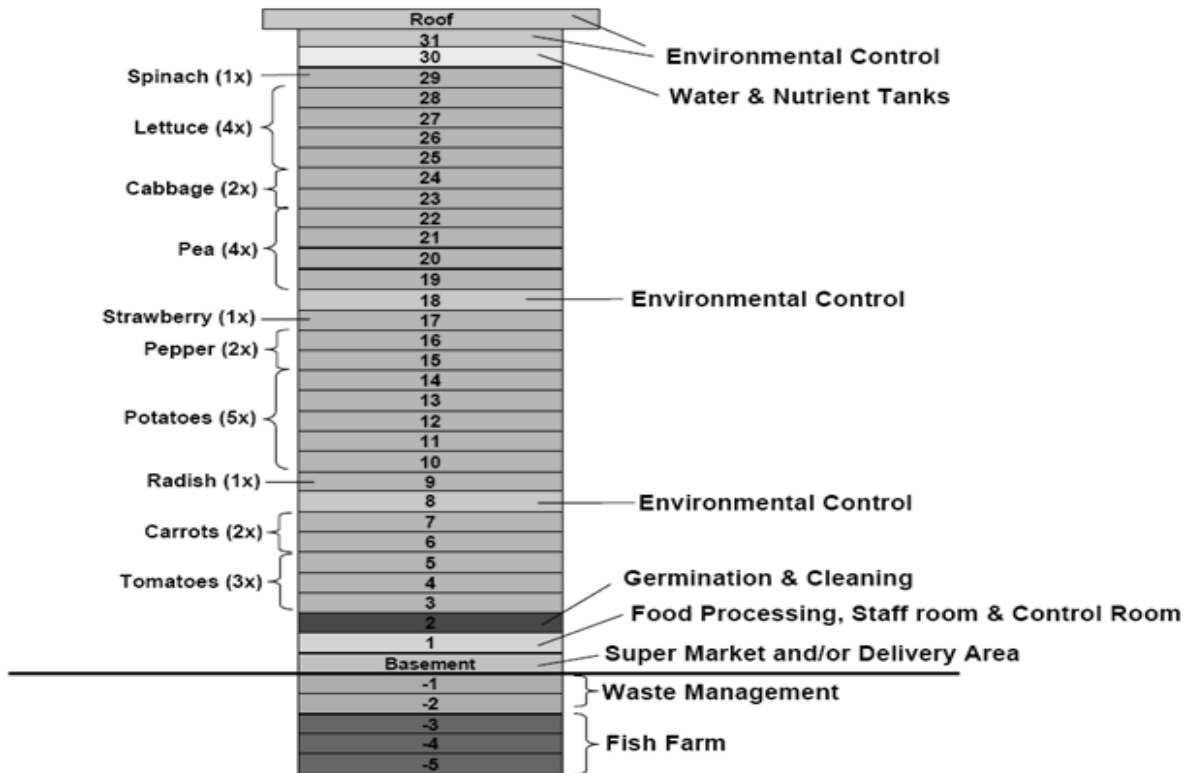


Fig 3: General Structure of Vertical Farming with its layout



Vertical Farming Methods

1. Hydroponics
2. Aeroponics
3. Aquaponics

1. Hydroponics

To grow food without soil, hydroponics uses the minerals in food. Hydroponics is defined in the Encyclopedia Britannica as "plants that grow in water-rich nutrients, with or without the mechanical assistance of an inert medium such as sand or gravel". The root of the word is the Greek words hydro and ponos, meaning "waterwork". While the idea of growing crops in water isn't new, the hydroponic business is. NASA scientists have identified hydroponics as a viable option for growing food in space. Onions, lettuce and radishes are just a few of the vegetables they have successfully grown. In general, scientists develop hydroponics by trying to make it more efficient, reliable and productive. Hydroponic grown crops provide good environmental, growth and growth management. Many forward-thinking countries have seen huge growth in hydroponic farming. Eurofresh is the largest supplier of commercial hydroponic greenhouses. Hydroponics is now widely used in commercial agriculture as it has many advantages over tillage. This method has the potential to reduce or eliminate tillage problems. Planting, laying, kneeling, and lifting soil is not a problem in hydroponics and is regular. Additionally, hydroponics is a less labor-intensive method of maintaining large-scale production facilities. It can also be safe as there is no animal waste. This method is also easier to control nutrients and pH because it uses hydroponic. It is important to remember that soil nutrients dissolve in water through erosion and soil minerals, and many factors such as temperature, oxygen and moisture levels can affect the nutrients taken from plants. When nutrients are balanced equally for each plant, hydroponic can produce similar results and more than any other method.

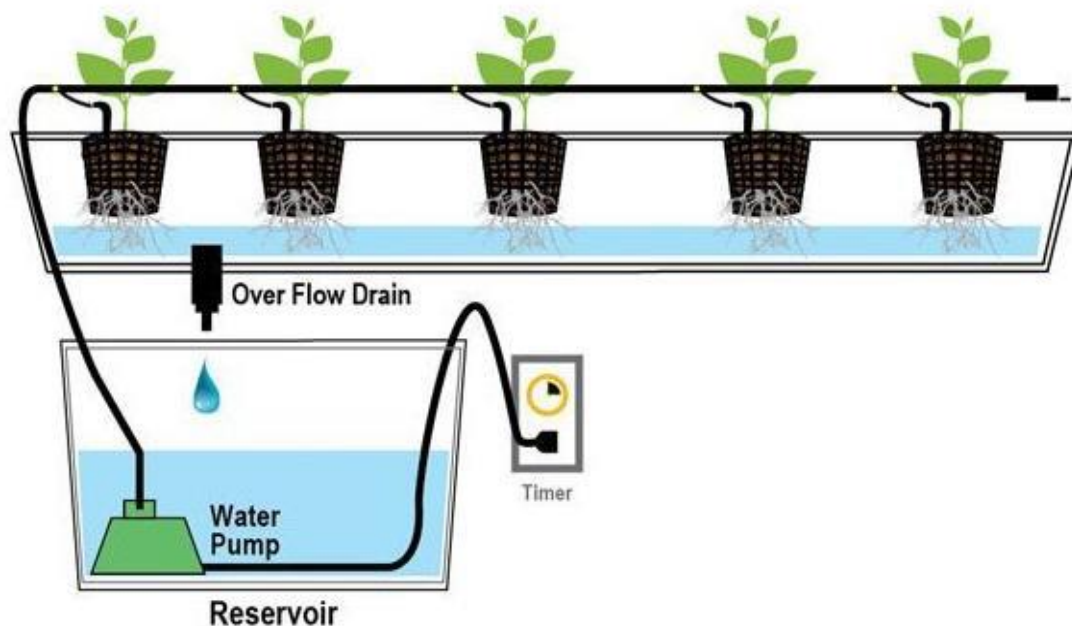


Fig 4: Schematic diagram of a hydroponic system

2. Aeroponics

Aeroponics represents an important step in hydroponics. Without soil or medium, with little water and sunlight, an aeroponic system can be defined as an air and water/food ecosystem that allows plants to grow rapidly. The main difference between hydroponics and aeroponics is that the former has no growing medium whereas the latter has water. Aeroponics does not need containers or trays to store moisture as it uses air or nutrients instead of water. Conventional farming uses 95% more water than hydroponic farming, but hydroponic farming requires only a small amount of space. You can even place plant boxes in basements or warehouses. When assembling a group of plant boxes, the upper and lower plants are brought out so that their canopies grow as their roots grow. The water-rich chemical mixture is sprayed onto the plants and the plants are fed. To save water, the mixed feed is recirculated when the system is completely shut down. Therefore, it is suitable for low water areas. The roots are suspended in the air or sprayed with nutrients in the grow room. Aeroponics has an advantage due to its excellent ventilation. During photosynthesis, all plants in the aquaponic system are exposed to CO₂ concentrations between 450 ppm and 780 ppm. Crops grow faster and use 70% less water than hydroponics. When it comes to hydroponic growing, compared to the best hydroponic systems, aeroponics is the most water efficient and does not require any changes in the growing environment. In addition,



aeroponics does not require the use of fertilizers or pesticides, as it does not use water. In addition, studies have shown that harvesting is easier and yield is higher with high-yield methods. For example, experimental aeroponic tomatoes in Brooklyn, New York quadrupled their crop yield in one year compared with one or more crops.

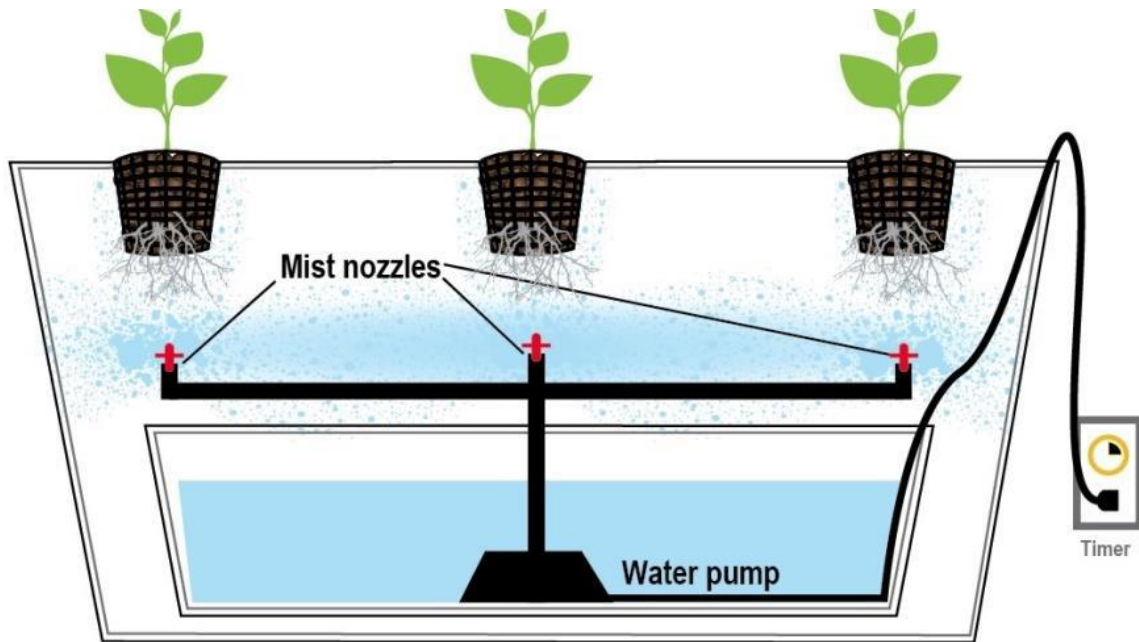


Fig 5: Schematic diagram of an aeroponic system

3. Aquaponics

When raising fish with hydroponic vegetables, flowers and herbs, a harmonious relationship can be established between fish and plants. Aquaculture and hydroponics combine to produce food in aquaponics. Traditional soil farming uses about 10% more water than an aquaponic system. Cities or dense rural areas where land is scarce or poor can benefit from these systems. These results can be achieved using hydroponic or recirculating aquaculture systems. In countries where food availability is an issue, aquaponics may be more profitable than conventional agriculture. In most aquaponic systems, 70% of the nutrients are absorbed by fish and plants, and the remaining waste can be used to grow fruit trees or traditional crops.

Aquaponics is a method of growing plants and fish in close proximity. As fish eat, they release metabolites into the water. After being further metabolized by bacteria, the plant growth medium is pumped into the end product of metabolism, which is taken up by the plant and used as food. For hydroponics, fish waste needs to be treated to remove ammonia, nitrates and other micronutrients from the wastewater for plants to thrive. Lettuce, herbs and specialty vegetables such as spinach, chives, basil and watercress can be grown in aquaponics. Aquaponics is the practice of using aquarium leachate to fertilize hydroponic production beds. Rhizosphere bacteria and plant roots help fish by removing nutrients from the water. Hydroponic production beds are "fertilized" with fish droppings, creating a healthy relationship between fish and plants.

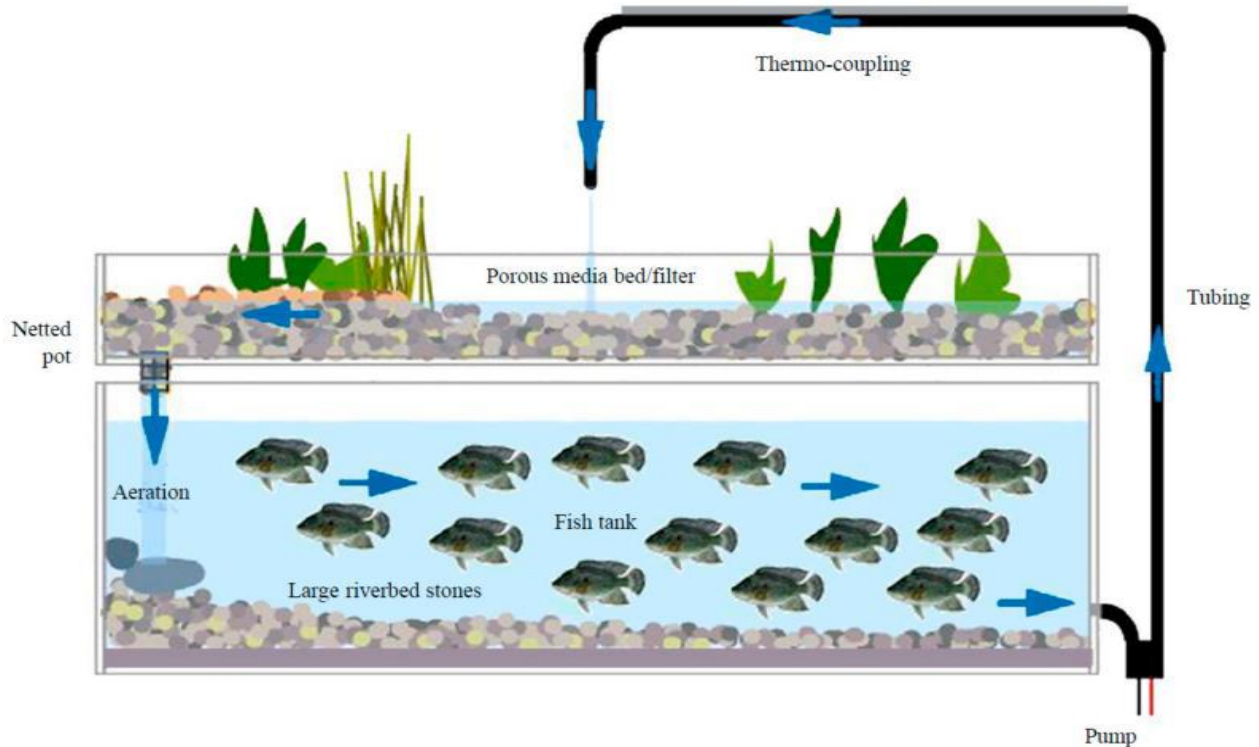


Fig 6: Schematic diagram of an aquaponics system

Need of Vertical Farming

- Food Security
- Climate Change
- Urban Density
- The Ecosystem
- Health
- Economics

Working of Vertical Farming

It's important to know how vertical farming works in order to understand the basic.

1. The physical layout
2. The lighting.
3. Medium for plant growth
4. Features of long-term viability

In order to maximise food production per square metre, crops are installed vertically in a vertical farming system. In order to ensure that the room is properly illuminated, both natural and artificial lighting is employed. Lighting efficiency can be improved with the help of devices like rotating beds. Hydroponics (plant roots submerged in nutrient solution) and aeroponics (plant roots misted with water) will be used instead of soil. Vertical farming often uses non-soil mediums like peat moss or coconut husks. There are numerous sustainability features that can help mitigate the energy costs of farming with in vertical farming method. Vertical farming, on the other hand, uses 95 percent less water compared to traditional farming.



Fig. 7: Well grown crops

Advantages of Vertical Farming

- Increased crop production.
- Protection from Weather-related Problems.
- Environment Friendly.
- Growing Higher Quality.
- Produce Conservation of Resources.
- Vertical Farming Flexibility.

Disadvantages of Vertical Farming

- High Initial Investment cost.
- High energy cost as growing plant is entirely with artificial lights.
- Excess nutrients used in vertical farming.
- Lot of garbage, plant residues, etc.
- Skilled labour requirement.
- High cost of LED lighting systems.
- Cost of production.
- Cost of maintenance.

FUTURE RESEARCH

This study only deals with the basics of long and laborious work in today's agriculture. Green Sense Farms and Aero Farms. Research in this area may also explore specific strategies and practices for different types of home farming in the future. There are many types of hydroponic methods such as technology technology (NFT), wicking systems, hydroponics, tidal (water and water), drip irrigation systems, and aeroponic systems. For example, more research is needed to accurately predict the advantages and disadvantages of different types of vertical farming .In the longer term, research should focus on the accessibility of vertical farming equipment developed in low- and middle-income countries. Researchers must develop and improve local farming methods to make vertical farming projects a reality in these countries. For example, they can build better water systems, install local water systems and use local solar power to provide free, clean energy for homes and businesses.

CONCLUSION

Food sustainability in urban areas can benefit greatly through the use of vertical farms. This is important whenever the city's population is expected to grow, as we are building for the long term. Vertical farming has many advantages over rural farming in terms of environment, health and economy. The needs of soil farming are influenced by new cultivation techniques such as hydroponics, aeroponics and aquaponics. Vertical farming is becoming more and more popular when it comes to increasing crop



yields. Land and waterless areas and the poorest and most landless can benefit greatly from vertical farming, which allows crops such as short crops such as forage corn, potatoes and vegetables to grow very little each year. Place, labor demand is low. The future growth of vertical farming in India is expected to be huge. Low-cost hydroponic and other low-cost farming methods should be developed with the aim of improving commercial vertical farming and reducing start-up and operating costs. For low-income families, affordability is a major concern when using vertical farms. Slums, food deserts and other crises are ravaging these people today. There are many variables that affect the success of vertical farming, such as the availability and quantity of food, population size, advances in technology, culture and nutrition, energy and water. It is also used as a material in superior cases involved in urban or rural agriculture and different food production. Vertical farming can be a sustainable way of producing food or related services in the city. The planning of mission and future vision is to build a sustainable city of around the world. As a result, technologies are already in place to create an urban environment where most of people's needs can be met with the of its own design, and where the recycling and reuse of drinking water is not neglected. As long as there is sufficient motivation and social interest, the eco-city of the future can be realized very quickly. Finally, the concept of vertical farming in urban areas seems to be the solution to many problems related to food production and environmental degradation. VF can be done under good conditions also helps reduce poverty, improve food security and improve human health with environmental safety.

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