

Vertical Farming - A Sustainable Future of India

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SUMMARY

By 2050, the population is expected to reach 8.9 billion and feeding such a large population will be the toughest part. The world has to produce 50% more food, thereby requiring an additional arable land that is simply not available. It is postulated that by 2050, the amount of arable land per capita will be less than 0.20 hectares, which is less than a third of what it was in 1970. Due to urbanization, every day we are losing lands that could be used for farming and cultivation. Studies observation suggests that the Earth has lost 1/4th of its arable lands over the last 50 years. India is the country with the maximum population and is evolving every day with something new. Industrialization is increasing dramatically due to which many arable lands are at greater risk.

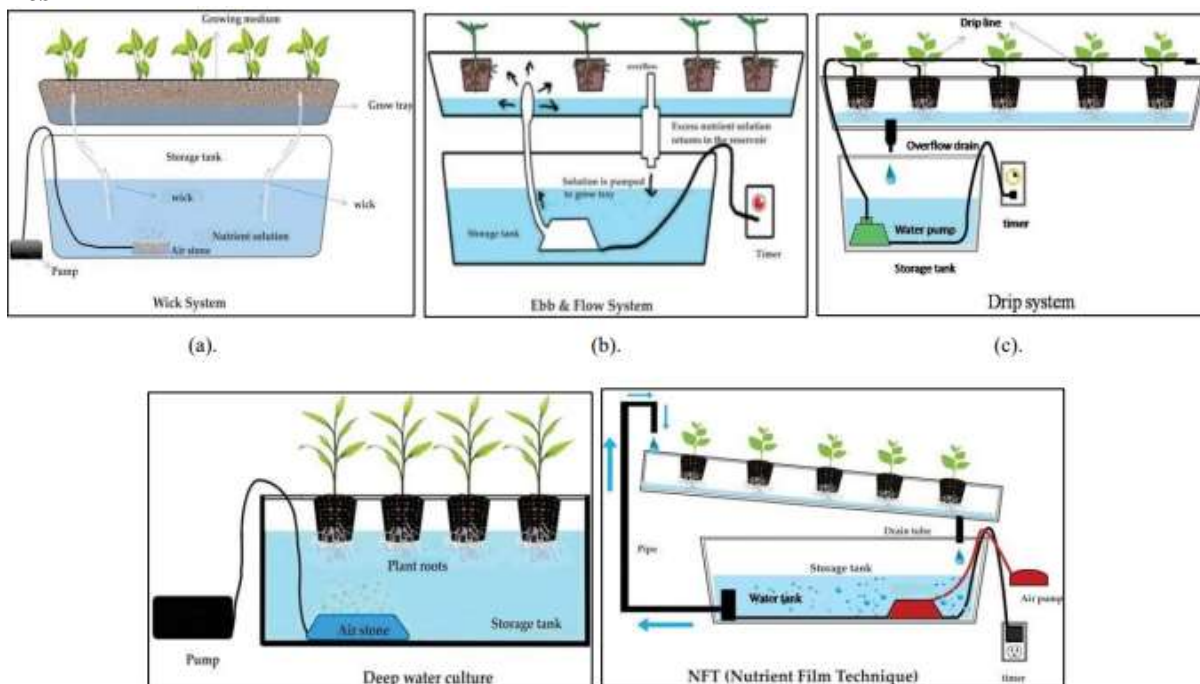
INTRODUCTION

Vertical farming is the method through which crops are grown in vertically stacked layers. It is an innovative way of maintaining our agricultural practices. It is mostly polyhouse-based farming in India. As an alternative to soil based farming systems, this technique could potentially serve as a complementary system to help alleviate the current shortage of fertile land and water. Gibbert Ellis Bailed coined the term “Vertical farming” and wrote a book titled “Vertical farming” in 1915. The concept of vertical farming was first pioneered by Dickson Despommier in 1999.

Techniques of Vertical Farming

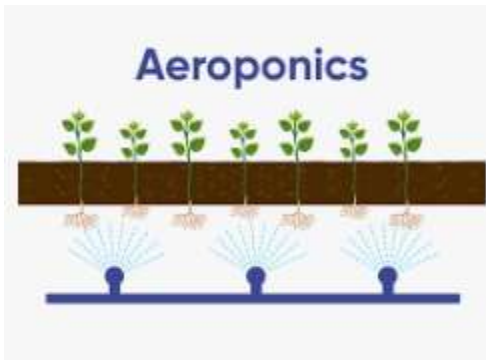
Many vegetable crops like spinach, okra, cucumber, onion, carrot and tomato can be grown successfully under vertical farming which shows improved yield and better nutritional status. Hydroponics, aeroponics, aquaponics, rooftop farming etc., are some of the methods of vertical farming which includes growing mediums and controlled-environment agriculture which aims to optimize plant growth. Media used in vertical farming are vermiculite, perlite, cocopeat, rock wool etc. Many vertical farms have been able to minimize facility-related costs by using existing structures, such as shipping containers, old factories, and abandoned office buildings. Alternatively, they can be built in barren land unsuited for conventional agriculture.

Hydroponics



“The cultivation of plants in nutrient-enriched water, with or without the mechanical support of an inert medium such as sand or gravel”. William Frederick Gerick pioneered in Hydroponics at the University of California at Berkley in early 1930’s. Even though the idea of growing crops in water isn't new, the commercialization of hydroponics is relatively recent. Hydroponics has been identified by NASA researchers as a viable option for growing food in outer space. Onions, lettuce, and radishes are just a few of the vegetables they've had success growing. It is now widely used in industrial agriculture because of its many advantages over soil-based cultivation. Weeding, tillage, kneeling, and dirt removal are non-issues, low-maintenance less labour-intensive method for managing large production areas. When nutrients are evenly distributed to all plants, hydroponics can produce more consistent and higher yields. Some of the most frequently used Hydroponic systems are nutrient film technique, ebb-flow, drip, deep water culture, wick etc.

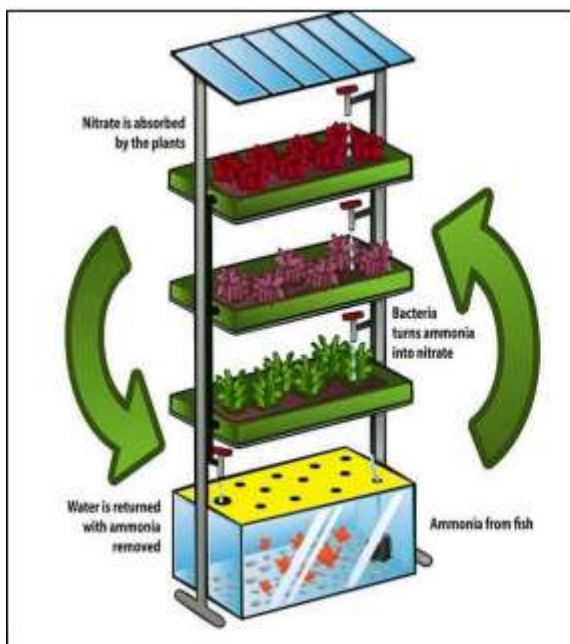
Aeroponics



Rooftop Farming

Aeroponic system can be defined as an enclosed air and water/nutrient ecosystem that causes rapid plant growth. The primary distinction between hydroponics and aeroponics is the absence of a growing medium in the case of the former and the inclusion of water in the latter. It does not necessitate containers or trays to retain water because it uses mist or nutrient solutions rather than water. Roots suspended in air are sprayed or misted with nutrient solution in growing chambers. The major advantage is its excellent aeration. During photosynthesis, plants in an aquaponics system have complete access to a range of CO₂ concentrations between 450 parts per million (ppm) and 780 parts per million (ppm). When it comes to soilless growing techniques, aeroponics is the most water-efficient and necessitates no replacement of the growing medium compared to the most effective hydroponic systems.

Aquaponics



When fish farming as well as hydroponic vegetable, flower, and herb production are combined, mutualistic relationships among fish and plants can be created. Acquaculture and hydroponics are combined in aquaponics to

produce food. It is a method of growing plants and fish in close proximity to one another. When fish consume food, they excrete metabolites into the water. After being further metabolised by bacteria, the plant growth medium is pumped with the end products of this metabolism, which are absorbed by the plants and used as food well-suited to lettuce, herbs, and specialty greens (such as spinach, chives, basil, and water cress). Rhizobacteria and plant roots help fish by removing nutrients from the water. The symbiosis is achieved by fertigation of hydroponic production beds with nutrient-rich waste from fish tanks. This fish waste should be processed to remove ammonia, nitrate as well as other micronutrients from the waste stream such that plants can thrive.

Rooftop Farming

Fruits and vegetables can be grown on rooftops using rooftop farming. Rooftops are increasingly being viewed as a viable space for urban farming. It benefits the community by providing fresh produce, promoting small-scale urban agriculture, as well as providing tangible connections to food.

Advantages of Vertical Farming

1. Eco-friendly and a promising alternative to conventional farming.
2. Land requirement is quite low.
3. Year-round crop production.
4. Water consumption is 80 percent less; the water is recycled and saved.
5. Significantly reduces use of fossil fuels (farm machines and transport of crops).
6. Pesticide-free.
7. Makes use of abandoned or unused properties.
8. No weather related crop failures.
9. In cases of high-tech farms there is no real dependency on the weather.
10. Offers the possibility of sustainability for urban centers.

Disadvantages of Vertical Farming

1. High initial & operational costs
2. In addition there are costs for erecting the structures along with its automation like computerized and monitoring systems, remote control systems and software's, automated racking and stacking systems, programmable LED lighting systems, climate control system, etc.
3. Limited number of crops can be grown economically.
4. It cannot replace the tall growing plants like field crops.
5. Dependency on the technology more than conventional methods.
6. High energy usage & high level of skill is a prerequisite.

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