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Vertical Farming: A Supporting Technology to Agriculture

Pavithra S* and P.Lakshmipriya*
*Ph.D Agriculture Economics, DRPCAU, Pusa
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Introduction

New and innovative technologies in agriculture sector are coming up to face the challenges arising due to overgrowing population, water scarcity, climate change, labour scarcity and urbanization leading to reduction in arable land. The entire world on the verge of population explosion and gravest challenge is to feed the population. By 2050 world's population will be 9.7 billion and to serve this population there is a need to increase the food production by 70 percent more than today's production. Various technologies like irrigation practices, crop management, mobile technology, fertilizer and mechanization management and software's, like agri for managing their farms, robotics in agriculture are on its way to come. These technologies will definitely uplift the agriculture sector. Even though with all these new and modern technologies, food security is the biggest challenge with a decreased in arable land. Food and Agriculture Organization (FAO) reveal that arable land per person is projected to decrease by 2050 to one-third of the amount which was available in 1970. In this context a new technology called vertical farming placing step in producing high crop yields within a small area.

Vertical Farming

vertical farming has completely changed and is confined to the aim of utilizing each and every inch of land and space, no matter whether it is urban or rural for growing maximum possible food for the hungry population. It is a practice of producing crops / plants in vertically stacked layers, vertically inclined surfaces and/or integrated in other structures (such as in a skyscraper, used warehouse, or shipping container). The modern concept of vertical farming

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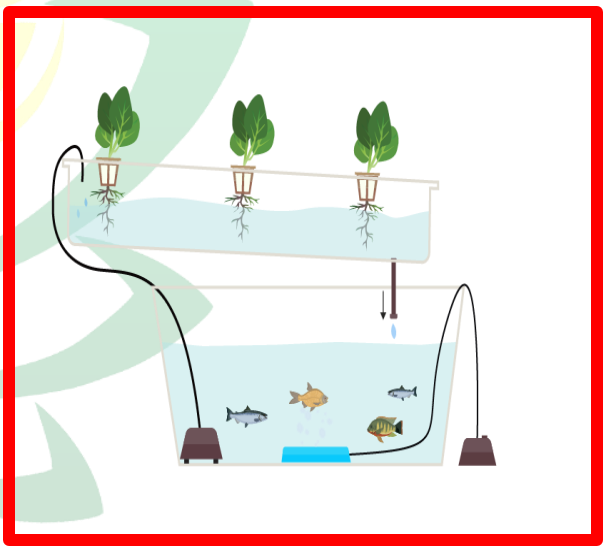
was proposed in 1999 by Dickson Despommier, professor of Public and Environmental Health at Columbia University.

What are the techniques in vertical farming?

There are three techniques of vertical farming, hydroponics, aeroponics and aquaponics.

Hydroponics refers to the technique of growing plants without soil. In hydroponic systems, the roots of plants are submerged in liquid solutions containing macronutrients, such as nitrogen, phosphorus, sulphur, potassium, calcium, and magnesium, as well as trace elements, including iron, chlorine, manganese, boron, zinc, copper, and molybdenum. Additionally, inert (chemically inactive) mediums such as gravel, sand, and sawdust are used as soil substitutes to provide support for the roots. The advantages of hydroponics include the ability to increase yield per area and reduce water usage.

Aquaponics



The term aquaponics is coined by combining two words: aquaculture, which refers to fish farming, and hydroponics—the technique of growing plants without soil. Aquaponics takes hydroponics one step further by integrating the production of terrestrial plants with the production of aquatic organisms in a closed-loop system that mimics nature itself. Nutrient-rich wastewater from the fish tanks is filtered by a solid removal unit and then led to a bio-filter, where toxic ammonia is converted to nutritious nitrate. While absorbing nutrients, the plants then purify the wastewater, which is recycled back to the fish tanks. Moreover, the plants consume carbon dioxide produced by the fish, and water in the fish tanks obtains heat and helps the greenhouse maintain temperature at night to save energy.

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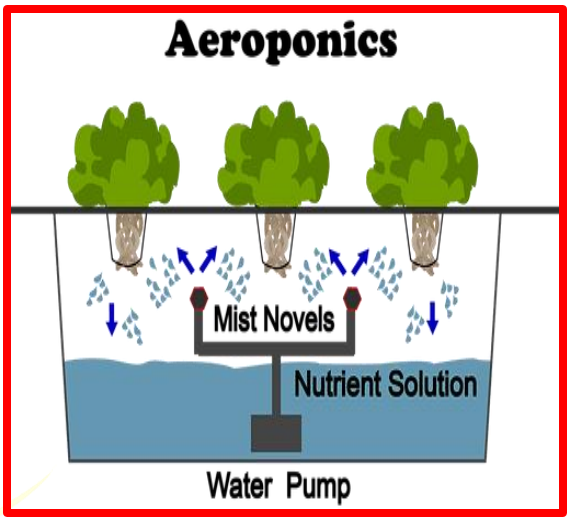
Aeroponics

The invention of aeroponics was motivated by the initiative of NASA (The National Aeronautical and Space Administration) to find an efficient way to grow plants in space. In aeroponics liquid solution with nutrients is misted in air chambers where the plants are suspended. It is the most sustainable soil-less growing technique, as it uses up to 90% less water than the most efficient conventional hydroponic systems and requires no replacement of growing medium.



Is it sustainable?

Sustainable agriculture is meeting society's food and textile needs in the present without compromising the ability of future generations to meet their own needs. Factors that make vertical farming sustainable are Water Usage, Efficient Use of Space, Creates a Nearby Food Source, Global Warming, Chemical Contamination. Water usage may be drastically reduced because the same water can be recycled time and again through the same hydroponic system. Fertilizer use can be greatly reduced and herbicides and pesticides for weed and pest control are unnecessary. Factoring in the economic benefits we enjoy as a result of clean oceans and thriving pollinators, it's clear that vertical farming offers real value to society. As long as the price of carbon emissions and environmental pollution is not priced explicitly, though, it will be difficult for many people to accurately perceive the benefits.

Advantages of vertical farming

Increased and year-round crop production: vertical farming allows to produce over 10 times more crop yield in 1 acre than traditional farming. In fact 1 acre of an indoor area offers equivalent production to 4-6 acre of outdoor capacity.

Usage of water is less: 70-95 % less water is required in vertical farming compared to conventional method.Climatic changes are not affected: as our agriculture is mainly based on weather factors, this new technology of indoor vertical farming is not affected by climatic factors which helps the famer to grow crops in all seasons.

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Resource conservation: Vertical farming would reduce the amount of farmland, thus saving many natural resources. Deforestation and desertification caused by agricultural encroachment on natural biomes could be avoided.

Limitation of vertical farming

- **Investment:** It requires huge initial investment cost of building skyscrapers for farming, combined with other costs such as lightning, heating, ventilation labour and other costs are more.
- **Employment opportunities:** conventional method of agriculture has the advantage of providing employment whereas in vertical farming there is less employment opportunity as it is fully automated and mostly skilled labours are required.
- **Marketing:** crops produced in the vertical farming may faces marketing problems as its costs are high it needs well-structured markets.

Vertical farming in India

ICAR experts are working on the concept of 'vertical farming' in soil-less conditions, in which food crops can be grown even on multi-storeyed buildings in metros like New Delhi, Mumbai, Kolkata and Chennai without using soil or pesticides. Scientists at the Bidhan Chandra Krishi Viswavidyalaya in Nadia, already had initial success in working on vertical farming hydroponically on a small scale. Ideafarms, an Indian design-in-tech company is producing crops Vertical farms. Bengaluru based startup Greenopiais selling kits with smart self-watering pots, enriched soil and the right seeds. A Mumbai-based start-up firm U-Farm is using hydroponic gardening technique to customise modular farm for an individual apartment complex or for a supermarket. Many entrepreneurs are coming forward for vertical farming with high net returns.

Success story

Mr. Vipin Rao Yadav from Sonipat, Haryana. His initial investment was 1.5- 2 lakhs with 100 sqft area, 50 grow trays and flower seeds. At present his earning is 45,000 -50,000/- per month with 1800 sq.ft area and 2500 grow trays.

Conclusion-

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Vertical farms can help to meet our growing population's needs by offering an additional way to produce food that does not share the same volatility and risk as conventional agriculture. Governments and industry groups can be valuable allies who view local food production as economic development. Though vertical farms can never be expected to replace traditional farms, it is likely that they will have to complement each other if we are to meet the food demands of tomorrow. It is environmentally friendly, tech-savvy, and most importantly, health-sensitive.