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A review on hydroponics: The art of soil-less farming

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Abstract
Soil-based agriculture is currently facing challenges as a result of several man-made elements such as industrialization and urbanization. Furthermore, unforeseeable natural disasters, climate change, and unchecked chemical use in agriculture impair soil fertility and quality. As a result, scientists have developed a completely new alternative form of growing known as hydroponics, commonly known as soilless agriculture. Plants can be cultivated hydroponically by immersing them in a nutrient-rich water solution. Hydroponics can be used to cultivate a wide range of plants, crops, and vegetables. In general, hydroponically grown produce outperforms soil-grown produce in terms of nutritional value, flavour, and yield quality. This agricultural practice is gaining popularity in both developed and developing countries throughout the world. Along with sophisticated space research, it has the ability to fill the void left by a lack of adequate cultivable land in many countries. As a result, hydroponics would be a superior technique to producing numerous fruits, vegetables, and livestock feed, as well as meeting future global nutrition requirements. In the future, hydroponics may emerge as a new method of feeding the world's population.

Keywords: hydroponics, industrialization, soil fertility, nutrient rich solution

Introduction
Hydroponic and aeroponic growing technologies are commonly used in no-soil farming. The Greek words "hydro" (water) and "ponos," which signifies labour, were combined to generate the term "hydroponics." It is a method of growing plants without soil that makes use of mineral nourishment solutions. Terrestrial plants can be grown with their roots only in the mineral fertiliser solution or in an inert medium such as perlite, gravel, or mineral wool. Hydroponics is a way of growing plants without soil while keeping their roots submerged in a nutrient solution. This strategy assists in managing the production system for effective use of natural resources, reducing malnutrition, and tackling the challenges brought by climate change. Aeroponics is a similar process to hydroponics, with the exception that plants are cultivated utilising small drops (a mist or aerosol) of nutritious solution. In 1946, an English scientist named W. J. Shalto Duglas established a laboratory in the West Bengal region of Kalimpong and brought hydroponics to India. Hydroponics Another book he has written on the subject is titled The Bengal System. Commercial hydroponics farms were later established in Abu Dhabi, Arizona, Belgium, California, Denmark, Germany, the Netherlands, Iran, Italy, Japan, the Russian Federation, and other countries in the 1960s and 1970s. Several computerised and automated hydroponic farms sprouted up all over the world in the 1980s. Home hydroponics kits became popular in the 1990s.

Crops Grown in Hydroponic or Soilless Environments
It is essentially possible to develop any form of fruit, vegetable, grain, or other crop with this method. Hydroponically grown flowers have exceptional colour and bloom. The hydroponics system can be mechanised, making it more controllable and useful for harvesting finished commodities. Many plants, including edible and medicinal plants, can be grown in soilless or hydroponic environments (Sardare and Shraddha, 2013) [3].

Hydroponic Production of Fruits and Vegetables
Food security began to take on greater importance when demand for sanitary food surpassed supply. Drought, heavy rain, floods, high temperatures, pests, and other effects of global warming and climate change have a variety of effects on plants. Natural resource availability, soil fertility, and water quality are more influential in hydroponic vegetable cultivation than in traditional soil-grown vegetable production. Farmers prefer hydroponic technology over traditional crop cultivation methods for some crops, such as popular food crops and temperate lettuce and herbs that are generally imported (Wattanapreechanon and Sukprasert, 2016) [5].

Using Hydroponics to Produce Fodder
Hydroponics fodder production is growing plants in a greenhouse (using high-tech or low-cost equipment) without soil but in water or nutrient solution for a limited time (about 7-8 days). Maize grain is preferred over other cereal grains for the production of hydroponic feed in India. Because it is palatable, easy to digest, and

nutritional, hydroponics fodder has extra health benefits. In instances when conventional green feed cannot be successfully farmed, farmers can produce hydroponically grown feed for their dairy animals using low-cost technology (Ramteke *et al*., 2019) [2]. According to the 19th Animals Census of 2012, the country has 529.70 million animals, including 199.08 million cattle (37.59%), 108.7 million buffaloes (19.89%), 71.56 million sheep (13.51%), and 140.54 million goats (26.54 percent). From 1951 to 2007, the growth rate for cattle (28.19 percent), buffaloes (142.72 percent), sheep (83.02 percent), and goats (197.76 percent) was on the rise, with an overall growth rate for livestock of 80.91 percent. (GOI, 2012). Because of the country's expanding livestock population and rigorous rearing technique, the demand for feeds and fodder has skyrocketed.

Crops Cultivated in Soilless or Hydroponic Environments

Using this technique, it is possible to cultivate any type of vegetable, fruit, fodder, or crop. Flowers bloom and colour better when planted hydroponically. Because hydroponics systems are mechanised, they are more controlled and better for end product collection. Several plants, including vegetables, fruits, flowers, and medicinal crops, can be cultivated in soil-free or hydroponic environments (Sardare and Shraddha, 2013) [3].

Providing Nutrients to the Plants

Hydroponics necessitates rigorous system monitoring due to the system's limited ability to buffer nutrients and its flexibility to respond quickly. Two aspects of nutrition must be considered: the supply of nutrients from the nutrient delivery system and the plant's reaction to nutrients. The majority of agricultural plants have critical nutrient levels established.

Limitations of Social Systems in the Absence of Soil

Despite its many advantages, soilless culture has several disadvantages. Although there are significant returns, commercial use necessitates technical competence and a significant upfront expenditure. Due to the high cost of soil-less culture, it is exclusively utilised for high-value crops. Controlling plant health must be done with extreme caution. Finally, the system need energy to work.

Future Potential of this Technology

Hydroponics, agriculture's fastest-growing business, may one day regulate how food is produced. People will use cutting-edge technologies such as hydroponics and aeroponics to build additional agricultural production channels when population grows and arable land declines due to bad land management. We only need to look at a few of the early adopters of this approach to see what the future of hydroponics will look like. Land in Tokyo is highly valuable due to the city's constantly rising population. To feed the population while protecting crucial land mass, the country has resorted to hydroponic rice farming. Rice is harvested in underground vaults without the use of soil. Because the environment is carefully regulated, four harvest cycles can be completed annually.

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