

Vertical Farming – The New Era Farming

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Abstract: With the expansion in human population and the change in their eating habits, we've to vary our traditional farming too; because the population is increasing, we are lacking with the resources. Specially our food resources. Now thanks to urbanization and Land- use conversion we also are face the matter on decreasing of agricultural land. Therefore, we are able to use this technology of vertical farming to attenuate this problem. Vertical farming technology has potential to impact the globe economically, environmentally and socially. We all know because of revolution there was tremendous increase within the agriculture yield production which was led by M. S. Swaminathan in year 1960. vertical farming is that a part of new agriculture revolution. Vertical farming may be a style of indoor farming that seeks to maximize production and efficiency per sq. ft by growing crops in multiple level on a vertical axis. the most aim of this paper is to introduce vertical farming its techniques, methodology, and also the best vertical farming technology using the simplest sustainable technique of agriculture to overcome the problem caused by tradition farming practices and growth. the utilization of specialized purple LED lights enables these crops to grow more efficiently than that of open horizontal farming. By farming inside the building, we will save land use, water, energy, chemicals, and transportation cost too.

Keywords: Farming nitrification, green revolution, land use conversion, vertical farming.

1. Introduction

"We have started living vertically, so why can't we do farming vertically"

India's arable area of 159.7 million hectares (394.6 million acres) is that the second largest within the world, after the US. Its gross irrigated crop area of 82.6 million hectares (215.6 million acres) is that the foremost important within the world. But due to lack of irrigation facilities we've got 312 million hectors ashore on seasonal basis. As per survey it is said that 90% of village population will settle in urban cities by 2030. Therefore, due to the population expansion and land use conversion there is lack of agriculture land. India is an agricultural nation where 70% of its people depending directly or indirectly upon agriculture. Agriculture had 15.4% share in economy of India in year 2017. Around 41.49% of total labor are associated with agriculture in year 2020. Farmer suicides account for 11.2% of all suicides in India. Activists and students have offered sort of conflicting reasons for farmer suicides, like anti farmer laws, high debt burdens, poor government policies, corruption in subsidies, failure, psychological state, personal

issues and family problems.

Farmer suicides in India refers to the national catastrophe of farmers committing suicide since the 1970s, thanks to their inability to repay loans mostly taken from private landlords and banks. The National Crime Records Bureau of India reported that a complete of 296,438 Indian farmers had committed suicide since 1995. Out of those, 60,750 farmer suicides were within the state of Maharashtra since 1995 and therefore the remaining in Odisha, Telangana, state, Madhya Pradesh, Gujarat and Chhattisgarh, all states with loose financial and entry regulations.

Therefore, we will minimize the water consumption by this technique of agriculture. Thanks to the limited access to irrigated agriculture land, there's a necessity for sustaining farming tasks so on pave the way for adding to food needs. Many aspects maintain food industry and processing such as: growth of population and its growing needs accordingly, reduction of natural sources because of growing cities, earth erosion, different kinds of contaminating, advent of biofuels, restrictions imposed on food production techniques laid low with customers and rule providers which needs better quality, less use of chemicals and plenty of useful environmental attempts 'from farm to fork.

Recently, environmental obsessions are mixed with rising obsession with health as architecture design is worried. Therefore, it's led to more interest in providing healthy food and incorporating it within the sustainable development project the answer to those issues is Vertical Farming. Vertical Farming has grown as a project which mixes the design of building and farms all directly during a high-rise building. VF is also a system of growing crops in skyscrapers, to maximize the utilization of land by having a vertical design whereby plants, animals, fungi and other life forms are cultivated for food, fuel, fiber by artificially stacking them vertically above each other. Vertical farms are now employed in many states. At present, these farms are largely grown and produce differing types of crops inside cities Top of Form.

2. Methodology of Research

Vertical Farming is a novel method of growing crops by artificially stacking plants vertically above each other either in skyscrapers or by using the third dimension of space. This might help to solve many of future's problems like malnutrition, polluted food etc. that could become evident along with food

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scarcity.

In this study, a qualitative and quantitative approach was chosen, for assessing and analyzing current Vertical Farming practices. In the first step, identifying existing and future Vertical Farming projects: related Websites, media and literature research from 2009 to 2017 resulted during a very total of identified projects in Europe, Asia, and America. In the next step, a comprehensive literature reviewed supported an analysis of varied documents published in accessible international resources on technologies and techniques that are utilized in VF projects. The study resources were formed from 63 different source types like journals, conference papers, theses, books moreover as standard, a report from Web of Science, Scopus, ProQuest furthermore as Google Scholar. They comprise 43 journals, 7 theses, 2 Books chapter, 2 conference paper and 9 websites of Vertical Farming. Most of them are related to recent years from 2007 to 2017. Selected criteria presented during this paper include technology using in Vertical Farming projects; spatial diversification; farming methods; Vertical Farming products and activities. within the subsequent section, Vertical Farming technology are visiting be explained thoroughly.

3. Vertical Farming Technology

Gilbert Ellis Bailey originated the phrase "vertical farming" and published the book "Vertical Farming" in 1915. In the University of California at Berkley, William Frederick Gerick pioneered hydroponics in the early 1930s.

In the 1980s, a Swedish ecological farmer named ke Olsson devised a spiral-shaped rail system for growing plants and proposed vertical farming as a way to produce vegetables in cities.

Professor Dickson Despouler invented the contemporary concept of vertical farming in 1999. His idea was to grow food in urban areas, saving time and money by reducing the distance and time it took to transport food from rural areas to cities. He wanted to cultivate food in urban areas so that fresher meals may be provided faster and at a lesser cost. Vertical farming is thus defined as the cultivation and production of crops/plants in vertically stacked layers and vertically inclined surfaces.

The plants are arranged vertically in a tower-like structure in the physical layout. This reduces the amount of space needed to cultivate plants. Then, to maintain a perfect atmosphere for effective plant growth, a combination of natural and artificial lights is used. The third component is the plant's growth medium. Growing media such as aeroponic, hydroponic, and aquaponic are utilized instead of soil.

A. Hydroponics

It is a method of growing food in water using mineral nutrient solutions without soil. The basic advantages of this method is that it reduces soil-related cultivation problems like soil borne insects, pest and diseases.

B. Aeroponics

The invention of aeroponics was motivated by the initiative of NASA (the National Aeronautical and Space

Administration, USA) to find an efficient way to grow plants in space in the 1990s.

In aeroponics, there is no growing medium and hence, no containers for growing crops. In aeroponics, mist or nutrient solutions are used instead of water. As the plants are tied to a support and roots are sprayed with nutrient solution, it requires very less space, very less water and no soil.

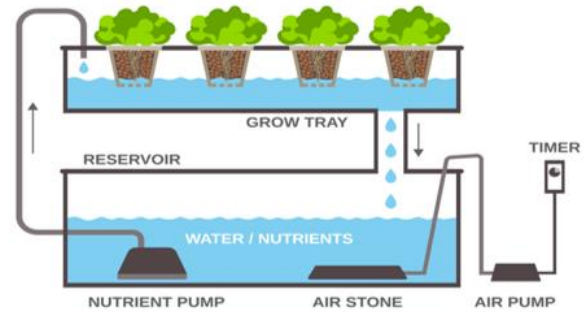


Fig. 1. Hydroponics

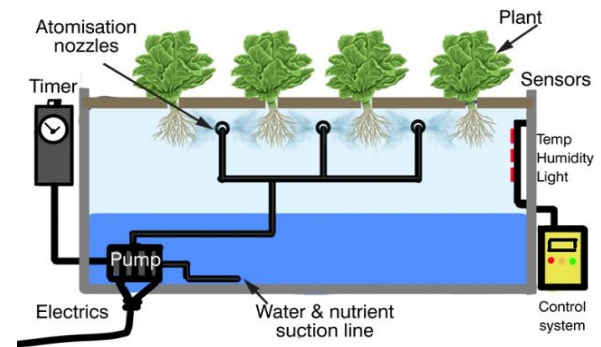


Fig. 2. Aeroponics

C. 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, to create symbiotic relationships between the plants and the fish.

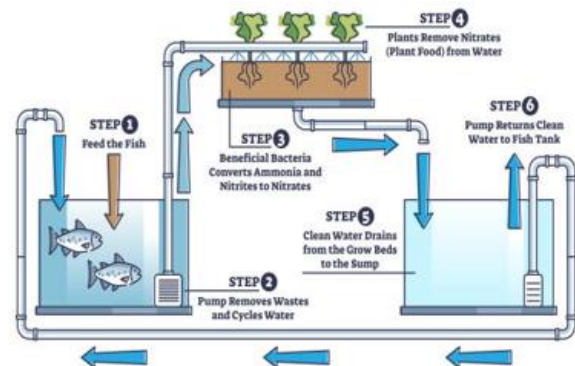


Fig. 3. Aquaponics

The symbiosis is achieved as nutrient-rich waste from fish tanks serves as “fertigate” to hydroponic production beds. In turn, the hydroponic beds also function as bio-filters that remove gases, acids, and chemicals, such as ammonia, nitrates,

and phosphates, from the water.

Additionally, the gravel beds provide habitats for nitrifying bacteria, which augment the nutrient cycling and filter water. Consequently, the freshly cleansed water can be recirculated into the fish tanks.

4. Important Feature of Vertical Farming

Vertical farms enable the producer to:

- Suitable for Grow food 24 hours a day, 365 days a year
- Protect crops from unpredictable and harmful weather
- Re-use of water collected from the indoor environment
- Provide jobs for residents/communities
- Minimize use of pesticides/fertilizers/ herbicides
- Drastic reduction and dependence on fossil fuels
- Prevent crop loss from storage/shipping/ long transportation
- Stop agricultural runoff, water saving up to 90%
- Pride of producing food – a euphoric feelings
- Education and training to school children in food production

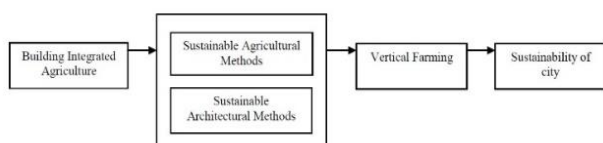


Fig. 4. The role of VF to the sustainability of an urban area

5. Challenges Faced in Vertical Farming Technology

The major challenges in vertical farming include:

1. Consideration of vertical farming as supplementary agriculture.
2. Partial or no plant-nature interaction.
3. Cost intensive cultivation.
4. Lack of expertise and infrastructure.
5. Development of suitable varieties and/or hybrids of suitable crops.
6. Generation of unpleasant odour/smell over the period (cannot be called a totally environment friendly technology).

6. Construction Cost

Its cost depends upon different aspects and ratios. Main elements are as follows,

1. Poly house.
2. Exhaust fan.
3. Vertical frame structures.
4. Containers for plantation.
5. Proper lights.
6. Pump house
7. Store room

Polyhouse establishment budget/ Cost of 1 acre Polyhouse

S.NO	MATERIALS	COST
1	Polyhouse sheet (54/sq.m)	216000
2	Natural vents(600/sq.m)	10000
3	Land development	20000
4	Drip and fogger	12500
5	Labour (16 men workers)	8000
	Total investment	266500

Fig. 5. Construction cost for polyhouse

Table 1
Result

Crops	Yield in VF due to Tech (tons/ha)	Field Yield (tons/ha)	Factor increase due to Tech	Factor increase due to Tech and Stacking
Carrots	58	30	1,9	347
Radish	23	15	1,5	829
Potatoes	150	28	5,4	552
Tomatoes	155	45	3,4	548
Pepper	133	30	4,4	704
Strawberry	69	30	2,3	368
Peas	9	6	1,5	283
Cabbage	67	50	1,3	215
Lettuce	37	25	1,5	709
Spinach	22	12	1,8	820
Total (average)	71	28	2,5	516

Source: Designed in a CE Study by the author at DLR Bremen.

7. Government Scheme on Vertical Farming

The government has launched a vertical garden scheme with a 75% subsidy. In which the candidate needs to put the investment of only 25% (Rs. 5835) of the total cost. In this article, we provide the complete information for you to apply for the subsidy.

Under the Mission for Integrated Development of Horticulture Scheme AAAP 2021-22, SHM-Kerala wants to popularise the user-friendly 'Arka Vertical Garden Structure' created and developed by the ICAR- Indian Institute of Horticultural Research, Bengaluru.

Credit linked back-ended subsidy @ 20% of the total project cost limited to Rs. 25 lakh per project in general area and Rs 30.00 lakh in NE Region, Hilly and Scheduled areas. However, for capital intensive and high value crops under protected cultivation and open-air cultivation of date palm, olive and saffron subsidy will be @ 25% of project cost with ceiling of Rs.50 lakh (33% of project cost with ceiling of Rs.60 lakh for scheduled and hilly areas).

8. Conclusion

Agriculture is one of the most important activities in the world for human survival.

However, while drinking water is in short supply, the majority of the available freshwater is already being used for agriculture. In industrialized countries, agriculture consumes more than 20% of all fossil fuels consumed annually. In recent years, farming has become increasingly centralized in terms of funding. The development of high-tech farming systems is the outcome of new energy sources and farming methods. Furthermore, urban overcrowding necessitates novel agricultural technologies in order to introduce traditional farming into cities. The ever-growing food production system

cannot be solved by a single technical strategy. Instead, a combination of multiple strategies is required to guide us in the right direction towards the 21 - century green revolution.

To summaries, the number of technologies available for reducing agricultural impact on the earth and oceans is limited, despite the fact that it helps to feed an ever-increasing human population. From our perspective, VF is one of the few unique paths to completely explore in the next 10 to 20 years, especially if we truly want to live in harmony with other living species and not endanger their or our own lives.

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