



Vertical Farming in India

(*Kriti Sharma and Yash Vardhan Singh)

College of Agriculture, MPUAT, Udaipur (313001), Rajasthan

*Corresponding Author's email: kritisharma101095@gmail.com

Agriculture in India is continuously moulting. Newer technologies 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. Various technologies like See & Spray Technology, field sensors for irrigation control, electrical conductivity sensing, machine learning and robotics in agriculture are on its way to come. These advanced technologies will no doubt boost the agriculture. Still then, in spite of all these latest and modern technologies, food security amidst the overpopulation pressure with decreasing arable lands is a major concern all over the world. Vertical farming is perhaps intensive way of increased food production with lesser lands.

Introduction

Vertical farming is cultivating and producing crops/ plants in vertically stacked layers and vertically inclined surfaces. The entire world is on the verge of population explosion and there is a gravest challenge of feeding the population. The population explosion has led to the decreased per capita land. Earlier with the aim of supplying the food to ever increasing population agricultural scientist stretched their innovative approaches to the tune of developing hybrid/ improved high yielding varieties, improved techniques, improved tools and implements, integrated practices in water, nutrient management and insect, pest management, greenhouse technology and even the genetically modified crops. All these efforts once were revolutionary, now sound inadequate.

In 1915, Gilbert Ellis Bailey coined the term “vertical farming” and wrote a book titled “Vertical Farming”. In the early 1930s, William Frederick Gerick pioneered hydroponics at the University of California at Berkley. In the 1980s, Åke Olsson, a Swedish ecological farmer, invented a spiral-shaped rail system for growing plants and suggested vertical farming as a means for producing vegetables in cities. Professor Dickson Despommier in 1999 came up with an idea of vertical farming. His concept was to grow the food in urban areas itself utilizing less distance and saving the time in bringing the food produced in rural areas to the cities. He intended in growing food within urban environments and thus have fresher foods available faster and at lower costs (Despommier, 2010).

Today, the context of 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 has now emerged as a new farming technology all over the world. In India also, vertical farming is stepping in actually. Many entrepreneurs are coming forward for vertical farming with high net returns. Vertical farming can be implemented in buildings, warehouses, rooftops and balconies (Montero *et al.*, 2015).

Systems of Vertical Farming

1. 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.

2. Aeroponics: 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.

3. Aquaponics: It is a bio-system that integrates recirculated aquaculture (fish farming) with hydroponic vegetable, flower, and herb production to create symbiotic relationships between the plants and the fish. It achieves this symbiosis through using the nutrient-rich waste from fish tanks to “fertigate” 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. Simultaneously, 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.

Advantages of Vertical Farming

1. The first and the major advantage of vertical farming is producing extremely high yields per available land or area.
2. Producing the food throughout the year without the risk of vagaries of nature of nature like floods, heavy rains, uneven rains, hail and snowfall, drought, dry spells, extreme high temperatures, cold waves, epidemics of pest and diseases, etc.
3. It reduces the cost over transporting loads of food grains from rural area to urban areas and reduce the spoilage occurring therein. Fossil fuel consumption in transporting the farm produce to cities from village places is also reduced to a greater extent.
4. Vertical farming uses 70 to 95 % less water compared to traditional farming
5. 90%less or no soil is needed in vertical farming and thereby no pest and disease infestations.
6. Pesticide free or organic food is produced as there is no use of pesticides.
7. Due to reduced food supply chain, consumers get the fresh produce with all its original nutrient qualities.
8. High productivity per unit area i.e., almost 80% more harvest per unit of area in vertical farming.
9. It will lead to greening of the urban areas and help to reduce the rising temperatures and mainly the air pollution in cities.

Disadvantages of Vertical Farming

1. Initial high cost for establishing the vertical farming system is the major problem. It will include the cost 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.
2. High energy cost as growing plant is entirely with artificial lights.
3. The excess nutrients used in vertical farming may interfere and contaminate the main urban water system if not taken care of.
4. LED lighting systems emit heat though small amount will create problem of maintaining the temperatures especially in summer months and may overload the air conditioning systems which will again incur high energy cost.
5. Lot of garbage, plant residues, etc. will be generated around the buildings with vertical farming which needs to be dispose of properly.
6. Skilled workforce will be unavailable initially and will need to be trained.

Feasibility of Vertical Farming in India

India is one of the largest producers of vegetables, fruits and many other agricultural commodities. In India, vertical farming has been introduced. 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 have already had initial success in working on vertical farming hydroponically on a small scale. Small-scale adaptations of vertical farming have been seen in Nadia, West Bengal and in Punjab. Bidhan Chandra Krishi Vishwavidyalaya in Nadia has found initial success in growing brinjal and tomato. Punjab also has succeeded in producing potato tubers through vertical farming (Kalantari *et al.*, 2018). Idea farms, an Indian design-in-tech company is producing Vertical farms grow and is preferred because their food is organic, of high quality and the supply is predictable. A Bengaluru based start-up Greenopias selling kits with smart self-watering pots, enriched soil and the right seeds. The sensor-embedded pots replenish moisture in the soil on a need basis, and notify you when you need to refill water externally. A Mumbai-based start-up firm U-Farm Technologies is using hydroponic gardening technique to customise modular farm for an individual apartment complex or for a supermarket. More and more number of start-ups in vertical farming are coming up in India (Graamans *et al.*, 2018).

Conclusion

Vertical farming is definitely a solution to critical problems in Indian farming like lack of supply or oversupply of farm produce, overuse of pesticides, overuse of fertilizers, deteriorating soils and even the unemployability. But there are challenges like acceptance of vertical farming by Indian farming community. Indian farmers are facing various problems like lack of electricity supply throughout the day, assurance of minimum support prices, no control over market glut, water scarcity, etc. The initial huge cost of infrastructure for a large-scale farm is a major hurdle for implementing vertical farming in India. Vertical farming in India has to face other challenges like public awareness, inclusiveness of farming community, technical know-how, cost incurred in managing and mainlining the vertical farm systems, and also its economic viability.

References

1. Despommier, D. 2010. *The vertical farm: feeding the world in the 21st century*. Macmillan.
2. Graamans, L., Baeza, E., Dobbeltstein, A. V. D., Tsafaras, I., and Stanghellini, C. 2018. Plant factories versus greenhouses: comparison of resource use efficiency. *Agricultural Systems*, **160**: 31-43.
3. Kalantari, F., Tahir, O. M., Joni, R. A. and Aminuldin, N. A. 2018. The importance of the public acceptance theory in determining the success of the vertical farming projects. *Management Research and Practice*, **10**(1): 5-16.
4. Montero, J. I., Muñoz, P., Llorach, P., Nadal, A., Sanyé-Mengual, E. and Rieradevall, J. 2015. Development of a building-integrated roof top greenhouse in Barcelona, Spain. *International Symposium on New Technologies and Management for Greenhouses-GreenSys*, **1170**: 839-846.