



## Vertical Farming: A Novel Approach Revolutionizing Agriculture

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The global population is increasing in rapid manner, while resources like soil, arable land and water etc. are decreasing. It is estimated that by the end of 2050 global population will reach 9.7 billion, to meet the food demand of ever-increasing population is a great challenge ahead of both scientific and farming community with limited resources. The traditional farming practices are labor intensive, prone to aberrant weather conditions, besides these climate change factors making conventional farming unprofitable. In addition, arable land decreasing through the anthropogenic activities like industrialization, urbanization and other projects potentially leading to shortages of farmland. These changes may dictate the search of novel food production technologies as current practices of agriculture may not be able to satisfy the future food demand with limited land and other resources. Hence, a novel approach called Vertical Farming (VF) came into limelight. The main objective of the VF is enhancing production per unit land used for cultivation. The term vertical farming, was suggested by Dickson Despommier, to denote the food production in vertically stacked layers contrast to conventional horizontal farming. VF can be profitably practiced in enclosed warehouses structures and shipping containers to rise crops in aquaponics or hydroponics which facilitates control growth of crops. Growth chambers are equipped with LED lights, nutrient supply, temperature control based on sensor technologies.

### Reasons to switch from conventional farming to vertical farming

**Demographic and social changes:** World population is increasing rapidly to feed this population we must increase food production by 70 % by 2050

**Resource scarcity:** Unfortunately, resources are going to exhaust soon or later so food production must increase with decreasing land and other resources.

**Volatility:** Agriculture is one of the most vulnerable sectors to climate change factors such as drought, high and untimely precipitation, extreme ambient air temperature, soil salinity causing huge economic losses to farming community.

**Inequality:** Besides the problems of malnutrition and hunger, poverty is widespread in developing countries, inequalities linked with food prices have also arisen in industrialized countries.

**How Vertical Farming Works:** it relies on four fundamental aspects they are described below

**Physical layout:** The main target of VF is to produce more crop per unit area, to achieve these crops are grown in vertically stacked layers in multi-storeyed structures.

**Light:** To get better productivity a suitable combination of natural and artificial lights essential. To enhance the rooting efficiency rotating beds are used.

**Growing medium:** Soilless cultures such as aeroponic, aquaponic or hydroponic are widely used in VF.

**Sustainability features:** With VF about 95% of water can be saved. Beside this energy can be saved. Hence this method is profitable and sustainable



## Vertical farming systems

**Hydroponics:** in this method crop is grown in aqueous solution enriched with mineral nutrients in soil less culture. The merits of this method are reduction of soil borne disease and pests and nutrient deficiency (3).

**Aeroponics:** it uses mist or nutrient solutions instead water to grow the crop. In this method growing media is excluded. To support plants anchoring is provided by support system and nutrient solution is applied at root zone. Hence, this can be practiced in less water, with less space in soil less culture (3).

**Aquaponics:** this system combines fish culture with cultivation of veggies, flower, and herb in hydroponic system results in symbiotic establishment of plant-fish relationships. It creates this symbiosis by “fertigating” hydroponic producing beds with nutrient-rich waste from fish tanks (3).

**Categories of vertical farming systems:** This classification is based on growing platform used for used and crops grown in VF.

## Horizontal growing platforms

**Stacked horizontal systems:** This type of VF system often uses existing commercial protected horticulture structures. This system consists of multiple horizontal growing platforms. Leafy veggies such as lettuce, herbs and other vegetables tomato and pepper are widely grown in glass houses deploying hydroponic systems.

**Multi-floor towers:** in this system instead of horizontal growth chambers, different levels of planting are placed in different tower structures. This enables versatile conditions to be maintained at each level of planting, this allows wider range of crops to be grown by tailoring the conditions of each level to best suit each crop.

**Balconies:** It is an alternative to multifloor towers. This system well suited for production on an individual or community basis rather than commercial enterprises.

## Vertical growth surfaces:

**Green walls:** these consist of vertical or inclined growing platforms positioned in front of buildings. However, easy of harvest and maintenance, and watering is major issues associated with this system.

**Cylindrical growth units:** In this type of system, plants are grown one above another around the surface of upright cylindrical units housing a nutrient supply (soil or hydroponic substrate) and located within a glasshouse or CE facility.

## Crops suited for growing in VF system

Micro greens  
Salad leaves  
Strawberry (*Fragaria spp.*)  
Lettuce (*Lactuca sativa*)  
Spinach (*Spinacia oleracea*)  
Tropical leafy vegetables  
Assorted leafy vegetables  
Culinary herbs

## Advantages of vertical farming

Facilitates round the year crop production  
Requires very less water



Insensitive to prevailing weather  
Complete organics management can be practiced  
Pesticide and other chemical usage can be minimized  
Efficient utilization of resources  
High benefit cost ratio

**Disadvantages of vertical farming**

High initial establishment cost  
Requires sophistication  
Trained personal is needed to handle

**Conclusion:** Vertical farming is emerged as frontier technology especially in urban areas. It offers opportunity overcome some key issues such as labor problem, indiscriminate use of pesticide and fertilizer, degrading lands and eroding soils, and unemployment among youths. However, its largescale among farmers challenged by high initial cost, technical knowledge of vertical farming. These can be overcome by providing training and use of locally available materials for establishing VF, it will save initial high cost.

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