



## Hydroponic Systems for Efficient Vegetable Growth

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Hydroponics is a technology for growing plants in nutrient solutions to use water containing fertilizers with or without the use of an artificial medium. The mediums like sand, gravel, vermiculite, rockwool, perlite, peatmoss, coir, or saw dust are used to provide mechanical support. It is also called soilless culture. Different soilless growing media available, coco peat is one of the cheapest and easily available media. It is highly productive with less labour and time, conserves water and land to protect the environment. This also overcomes problems like soil borne diseases, salinity, poor structure and improper drainage. This technique can be used in combination with protected environment for the cultivation of various horticultural crops where land is not suitable for the cultivation. Nowadays roof top and terrace gardening is gaining popularity in urban areas. There are many types of hydroponics systems that are being used in India.

### Types of Hydroponics systems

#### 1. Based on structure and material

##### a) A-Frame hydroponic system

- The A-Frame hydroponic system is a vertical garden designed to maximize the number of plants grown in a small space, without the need for soil. This setup uses affordable materials, including 2' x 4' boards for the frame, PVC pipes and tubing for water circulation, valves to control water flow and drainage, and a plastic tote as the reservoir.
- Each of the 12 PVC tubes in this system holds 14 plants, allowing for a total of 168 plants—an impressive number for the compact growing space of 6' wide x 6' tall x 10' long. Additionally, the system is portable.

##### b) U-Shaped hydroponic system:

- Plants are placed in grow tubes or channels attached to the U-frame.
- The nutrient-rich solution is pumped from the reservoir to the top of the U-frame and flows down through the grow tubes, providing nutrients to the plants. The solution then collects at the bottom of the U-frame and is recirculated back to the reservoir.

##### c) Vertical hydroponic tower:

A hydroponic tower is a type of vertical hydroponics system in which water flows through the roots from the top. Compared to soil gardening and other hydroponic systems, it can produce up to three times the harvest while using less space and water. However, it has higher initial and operating costs, is more susceptible to outages, and is less compatible with certain plant types.

##### d) Horizontal hydroponic system (HHS)

- Plants are typically arranged on flat surfaces. In this case, the plants' root systems receive nutrient-rich water solutions to support growth. The HHS (Hydroponic Growing System) consists of five cylindrical PVC pipes (45.5 cm high and 3.6 cm in radius), each filled with 130 g  $\pm$  0.5 g of perlite.

- Each pipe holds four plants placed in 4.4 cm square holes, arranged in rows. Each HHS contains 20 lettuce plants.

#### e) Trough system with substrate

- In this system, plastic containers are used in place of PVC pipes and are filled with substrates such as cocopeat, perlite, or vermiculite. Seedlings are transplanted into this medium, where they grow to maturity.
- Water and nutrients are supplied through a drip irrigation system, adjusted according to the crop's growth stage and needs. This setup is suitable for cultivating various horticultural crops, such as tomatoes, capsicums, and cucumbers.

#### f) Grow bags with substrate

- In this type of cultivation practice, small grow bags—typically white on the outside and black on the inside (now also available with a green exterior)—are used with substrates such as cocopeat and perlite.
- These grow bags are readily available in the market in various sizes and capacities. They can be used on land that is not suitable for traditional cultivation by placing the bags after some leveling of the ground.

### 2. Based on nutrient flow

#### a) Flood and drain hydroponic system

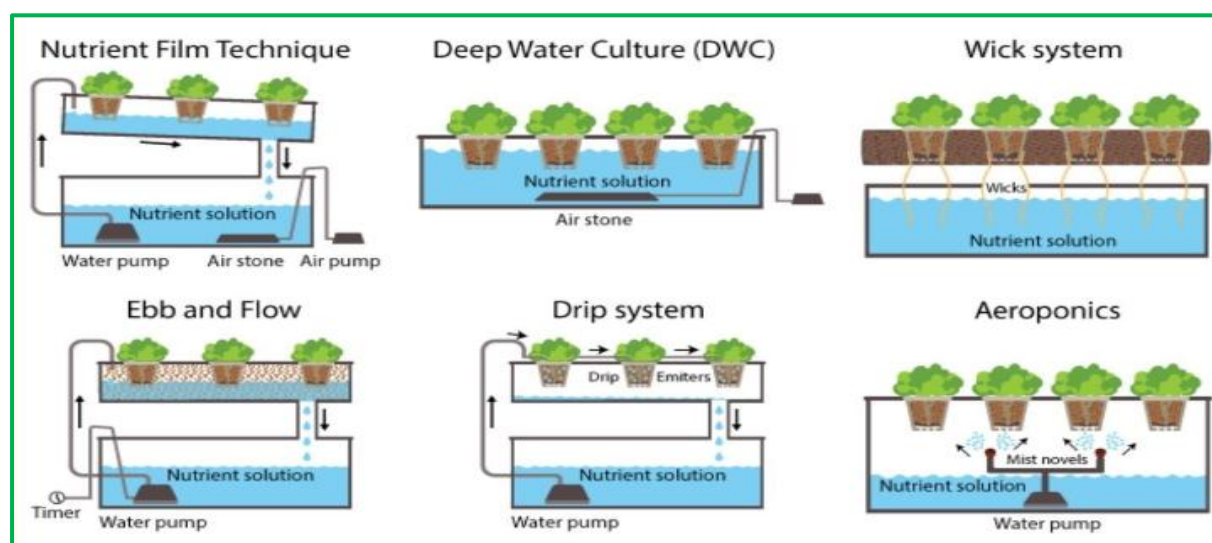
- The Flood and Drain Vertical (FDV) hydroponic system provides 66% more cropping area compared to open-field cultivation.
- This system, similar to the ebb and flow setup, includes a watertight growing bed and a tank of nutrient solution. At fixed intervals, the nutrient solution is pumped from the tank into the growing bed for a short duration (5-10 minutes).

#### b) Nutrient film technique (NFT):

The plant roots are directly exposed to a thin film (0.5 mm thick) of nutrient solution flowing through the channel. The growing medium absorbs the nutrient solution through the plant's porous root system. This method is suitable for a wide range of crops.

#### c) Deep flow technique (DFT)/ pipe system

- In this technique, a 2-3 cm deep nutrient solution flows through PVC pipes fitted with plastic net pots holding the plants. The plastic pots contain planting materials, and their bottoms touch the nutrient solution flowing through the pipes.
- A pump, tanks, valves, timers, and other accessories, including a nutrient monitoring system, are placed on the floor of the protected structure. The PVC pipes are arranged either in a single horizontal plane or in a multiple zig-zag vertical plane.



## Crops Suitable for Hydroponics System

Leafy greens, herbs, tomatoes, cucumbers, strawberries, lettuce and spinach.

### Advantages

1. Efficient use of water and nutrients
2. Faster plant growth
3. Higher yields
4. Space efficiency and vertical farming potential
5. Year-round production
6. Reduced risk of soil-borne pests and diseases
7. Decreased need for pesticides and herbicides

### Disadvantages

1. High initial cost
2. Technical knowledge requirement
3. Power dependency
4. Waterborne diseases
5. Monitoring and maintenance needs
6. Limited crop variety
7. Space limitations.

### Conclusion

Based on the hydroponic systems developed using the techniques mentioned, it can be concluded that A-frame, U-shaped, vertical tower, and horizontal hydroponic systems are suitable for small areas. However, trough and grow bag hydroponic systems are better suited for larger areas. It can also be concluded that all the nutrient flow techniques are effective for ensuring a uniform nutrient flow to the plant roots, which helps achieve higher production.

### References

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