

# Aeroponics for Sustainable Agriculture

Neelam Bunkar<sup>1</sup>, M. L. Jadav<sup>2</sup> and Pankaj Thakur<sup>3</sup>

<sup>1</sup>Guest Faculty, College of Agriculture Indore, RVSKVV, Gwalior

<sup>2</sup>Scientist, College of Agriculture Indore, RVSKVV, Gwalior

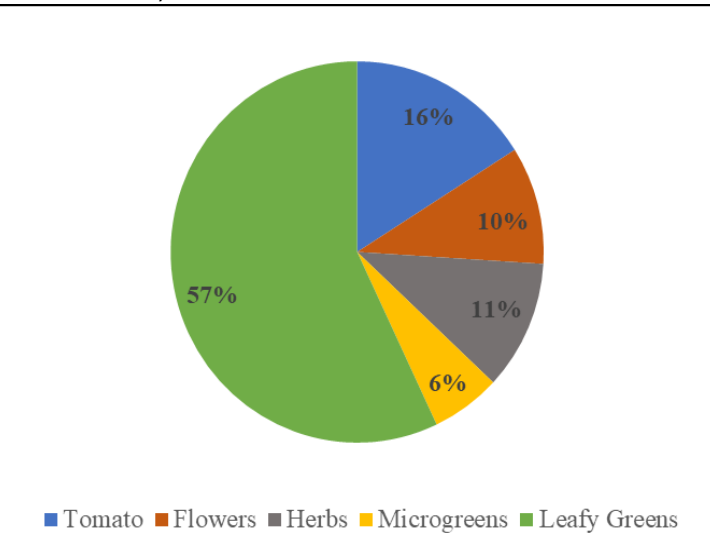
<sup>3</sup>Research Scholar, IIT Roorkee

Corresponding Author:

## Introduction

Aeroponic farming is the growing of fruits and vegetables without necessitating the need for soil. Aeroponic farming was first developed for academic purposes in the 1920s according to Living Greens Farm. It is the process of cultivating plants in an air or mist environment, eliminating the need for soil or an aggregate medium. The term "aeroponic" originates from the ancient Greek: aer (air) and ponos (labor, hardship, or toil).

In 1911 Artsikhovski designed the first aeroponic systems and demonstrated their effectiveness for plant cultivation. Several countries are trying to adopt new cropping techniques in several ways. There is some country in the world leading in aeroponics are California, Florida (Utilizes aeroponics for growing vegetables and herbs year-round), Texas: (Expanding its aeroponic systems for various crops, particularly in urban areas) and New York (Increasing interest in vertical farming and aeroponics for fresh produce in urban areas).



**Fig. 1. Percentage of different crop grown in aeroponics farming**

In India, Maharashtra Karnataka, Punjab and Tamil Nadu, where actively innovative farming techniques are being adopted. In India, a variety of crops are being grown using aeroponics, such as Leafy green (Lettuce, spinach, and kale are popular choices),

Herbs (Basil, mint, coriander, and parsley thrive in aeroponic systems), Vegetables (Bell peppers, tomatoes, and cucumbers), Fruits: Strawberries and certain types of melons) and Microgreens (These nutrient-dense young plants are ideal for aeroponic cultivation due to their rapid growth). Arrangement and percentage of different crop grown in aeroponics farming shows in figure 1.

To set an aeroponics farm several information are required to know such as

### Step 1: Planning and Design (Foundation of your aeroponic farm)

- **Crop Selection:** The first step is to decide what crops you want to grow. Not all plants are suitable for aeroponic farming. Leafy greens, herbs, and small fruits like strawberries often do well, but root vegetables and larger fruits may be more challenging.
- **Farm Layout:** Next, design the layout of your farm. Consider the size and shape of your land, the location of water and power sources, and the path of the sun across the sky.
- **Aeroponic System Selection:** There are several types of aeroponic systems available, including high-pressure, low-pressure, and vertical systems. High-pressure systems are more efficient but also more expensive. Low-pressure systems are cheaper and easier to set up but less efficient.
- **Infrastructure Planning:** This includes storage areas for tools and supplies, walkways for easy access to all parts of the farm, and possibly a greenhouse or indoor growing area if there is harsh climate.

### Step 2: Infrastructure Setup (Critical component that supports the entire operation)

- **Aeroponic Systems:** The heart of your farm is the aeroponic systems where your plants will grow. These systems can be purchased ready-made or custom-built depending on your needs and budget. They typically include growth chambers or towers where plants are housed,

and a system for delivering the nutrient solution, often through misters or sprayers.

- **Irrigation System:** An efficient irrigation system is crucial for delivering the nutrient solution to your plants. This usually involves a network of pipes or tubes that connect your nutrient reservoir to the misters in your aeroponic systems.
- **Lighting System:** If you're growing indoors or in a greenhouse, you'll need to install a lighting system. This could involve LED grow lights, fluorescent lights, or HID lights, depending on your crops' needs.
- **Environmental Control Systems:** Depending on your location and the crops you're growing, you may need to install systems to control temperature and humidity.
- **Power Supply:** Aeroponic systems require a reliable power source to run the pumps, lights, and environmental control systems.
- **Storage and Workspace:** Don't forget to plan for storage space for tools, supplies, and harvested crops. You'll also need a workspace for tasks like seeding and transplanting.

### Step 3: Preparing the Growth Medium and Planting (Preparing the growing medium)

- **Choosing the Grow Media:** In an aeroponic system, the growing medium is typically lightweight and porous to allow for optimal root exposure to the nutrient mist. Common choices include **coco coir, perlite, or clay pebbles**.
- **Filling the Net Pots:** The net pots, which hold the plants in the aeroponic system, are filled with the chosen grow media. The size of the net pots and the number of growing media used will depend on the type and size of the plants you plan to grow.
- **Planting:** After filling the net pots with the growing media, you can plant your herbs, seedlings, or other desired plants. This allows the roots to absorb the necessary nutrients and water directly from the mist.

### Step 4: Preparing the Nutrient Solution (Lifeblood of an aeroponic system)

The first step in preparing the nutrient solution is to choose a high-quality nutrient mix. These mixes are usually sold in concentrated form and contain a balance

of primary nutrients (nitrogen, phosphorus, and potassium), secondary nutrients (calcium, magnesium, and sulphur), and trace elements (iron, manganese, zinc, copper, molybdenum, and boron).

Then dilution of nutrient mix required with water according to the manufacturer's instructions.

Once nutrient solution is prepared, it's ready to be added in aeroponic system. The solution is typically stored in a reservoir and delivered to the plant's roots via a pump and misting system.

Over time, as the plants absorb nutrients, if more nutrient required the need to mix in the reservoir to maintain the correct concentration.

### Step 5: Monitoring and Maintenance

1. Regular monitoring of plant health, nutrient levels, and system functionality is crucial.
2. Consistent temperature and humidity levels are key to the success of aeroponic systems.
3. The nutrient solution used in aeroponics needs to be carefully managed.
4. Regular maintenance of the system is necessary to ensure its efficiency.
5. Despite the reduced risk of pests and diseases in aeroponic systems compared to traditional soil-based farming, it's still important to monitor for signs of pests and diseases and take appropriate action when necessary.

Today, aeroponics is widely recognized for its potential to revolutionize food production, especially in urban areas. Research continues to explore its applications in food security, sustainability, and climate resilience, making aeroponics a key player in the future of agriculture. In India, several initiatives and companies have successfully established aeroponic systems, showcasing its potential for sustainable agriculture. Here are a few notable examples of aeroponics farming startups, companies and research institutes:

1. **AeroFarms India-** This is award-winning vertical farming company which stated in year 2004, passionately solving agriculture's biggest challenges, growing real food for elevated flavor and a brighter future for all. There is several global problems solved by this company such as water scarcity problem by uses upto 95 % less water than regular field farm, Loss of arable land that resolved

by uses up to 99% less land than field and overuse of pesticides by growing crop using zero pesticides.

**2. InnoAgritech-** Based in Maharashtra, InnoAgritech specializes in aeroponic systems for growing high-value crops. They focus on developing small-scale, affordable systems that can be used by local farmers, promoting sustainable practices and improving yields. Their focus on sustainability not only aims to improve yields but also to promote environmentally friendly practices within agriculture. By making advanced farming technology accessible, InnoAgritech is dedicated to enhancing the livelihoods of farmers and contributing to more sustainable food production systems.

**3. UrbanKisaan-** UrbanKisaan operates vertical farms in urban areas, utilizing aeroponics to grow fresh vegetables and herbs. They aim to provide locally sourced produce, reducing the carbon footprint associated with transportation and promoting urban agriculture. UrbanKisaan started in 2017 that wanted to grow more than just fresh and nutritious food. Aim of this startup is to create a sustainable future for farming and feed the world in a way that is good for both people and planet.

By creating hyper-local urban farms, this company creating a completely transparent supply chain with a low carbon footprint. Growing techniques of this company help us save up to 95% water yet grow 30x more when compared to traditional farming.

**4. Research Institutions-** Various agricultural universities and research institutions in India, conducted several research on aeroponics, exploring its feasibility for different crops and conditions.

- **Indian Agricultural Research Institute (IARI):** Located in New Delhi, IARI conducts research on various agricultural practices, including soilless farming techniques like aeroponics.
- **Indian Institute of Technology (IIT) Kharagpur:** IIT Kharagpur has programs focusing on agricultural technology, including research in aeroponics and vertical farming.
- **National Institute of Agricultural Engineering (NIAE):** Part of the Indian Council of Agricultural Research (ICAR), NIAE works on innovative agricultural engineering solutions, including aeroponic systems.

- **Tamil Nadu Agricultural University (TNAU):** TNAU conducts research on modern farming techniques and has initiatives related to aeroponics and hydroponics.
- **Punjab Agricultural University (PAU):** PAU is involved in various agricultural research projects, including studies on soilless cultivation methods like aeroponics.
- **Gujarat Agricultural University:** This university is also involved in research and development in various agricultural practices, including aeroponic systems.
- **International Crops Research Institute for the Semi-Arid Tropics (ICRISAT):** While primarily focused on dryland agriculture, ICRISAT explores innovative farming methods that include aeroponics

It's an advanced method of growing plants in an environment where their roots are suspended in the air, with little or no growing medium. Instead of soil, plants are nurtured by a nutrient-rich mist or aerosol. This technique optimizes several factors for plant growth, including moisture, nutrients, and oxygen, resulting in faster growth rates and higher yields compared to traditional soil-based farming.

#### Applications of aeroponics

- **Commercial Farming:** Aeroponics is increasingly used in commercial greenhouses and vertical farms for crops like lettuce, herbs, and strawberries.
- **Research and Education:** Many universities and research institutions use aeroponics for studying plant growth and development.
- **Home Gardening:** Home gardeners are also adopting aeroponic systems for growing herbs and vegetables indoors.

#### Challenges

- **Technical Complexity:** Aeroponic systems can be more complex and require careful monitoring of nutrient levels and misting cycles.
- **Initial Cost:** The setup for aeroponics can be more expensive compared to traditional gardening methods.
- **Power Dependency:** The systems rely on electricity for pumps and misters, making them vulnerable to power outages.

---

**Conclusion**

Aeroponics represents a promising agricultural innovation, particularly in the context of urbanization and the need for sustainable food production. By

utilizing technology to enhance plant growth, aeroponics has the potential to revolutionize how we cultivate crops, contributing to food security and environmental sustainability.

\*\*\*\*\*