



# **FARMING AT HOME**

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## Soil Less Food Production at Homes

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**ABSTRACT:**

An inventive way to grow plants without traditional soil is soil-less food production at home, often known as hydroponics or aquaponics. Instead, plants are cultivated on inert media like perlite or coco coir or in nutrient-rich water solutions. This approach is suitable for urban areas or places with little access to arable land since it makes efficient use of water, space, and nutrients. Vegetables, herbs, and even some fruits are capable of being grown year-round by individuals by regulating environmental elements like light, temperature, and pH levels. A simple and ecological method of growing fresh produce at home, soilless food production encourages self-sufficiency and lessens dependency on traditional agriculture. Growing food without soil at home is a step toward sustainable agricultural methods and provides an environmental alternative to traditional farming operations. It gives people the ability to take charge of their food supply regardless of space or location limits because it can be used both indoors and outdoors. In addition, crop yields and quality are improved by the capacity to adapt fertilizer solutions to meet the needs of particular plants. Soil-less techniques emerge as a feasible way to address the growing needs of society for local food production and lower carbon footprints, all while promoting household food security.

**KEYWORDS:** Soilless farming, composting, terrace garden, hydroponics

**SOILLESS AGRICULTURE**

Soilless farming, by definition, entails the cultivation of crops without traditional soil utilization. Unlike conventional farming, where soil serves as the primary medium for delivering essential nutrients to plants through their roots, soilless farming employs pre-mixed essential nutrients within a water reservoir, known as the aerated nutrient solution (see Figure 1). These nutrients are efficiently transported to the roots, alongside other meticulously controlled environmental parameters such as high oxygen levels, optimal temperature, and pH. The three predominant methodologies of soilless farming utilizing aerated nutrient solutions are hydroponic, aquaponic, and aeroponic systems. Additionally, soilless farming encompasses the cultivation of crops using porous substrate culture as a growth medium, thereby eliminating reliance on natural soil. The paramount concern arises from the assessment provided by the FAO's representative during the 2014 World Soil Day forum, indicating a looming depletion of the world's primary soil reservoir within a span of 60 years. Furthermore, approximately one-third of the global soil has already undergone degradation. A disconcerting revelation was



made that the generation of a mere 3 cm layer of topsoil demands an astonishing timeframe of 1000 years. Consequently, there is an urgent call for the adoption of novel sustainable methodologies to fulfill the escalating dietary requirements of a burgeoning populace, safeguarding global food security, and confronting the pressing issue of soil deterioration.

Soilless cultures are considered a newly developed technique for crop cultivation. Instead of soil, substrates are well-adopted for vegetable cultivation and other greens. The soilless medium could be either inorganic (gravel, perlite, rock wool, vermiculite) or organic (rice husks, peat, sawdust, straw, coconut coir) and mixed. Therefore, to choose locally available, cheap and better adaptable substrates are used. The growers can adopt the soilless cultivation according to their needs, the place of the system and according to their potential yield and interest to grown traditional vegetable cultivation. The system in any case needs to take strong care and observation of the parameters needed for the good growth of the plants such as nutrient concentrations, light, oxygen around the plant's root zone, water quality, pH, temperature in the grow bag level.

Among the substrate coir is a 100% natural fiber obtained from an inexhaustible asset of coconut husk. Coir strands take after the wood filaments regarding actual properties and compound organization. Coconut strands are seen firmly stuffed alongside non-sinewy, cushioned, and lightweight corky material known as coir substance or coir dust, which comprises around 50-70 percent of the husk. The elastic material that ties the coir fiber in the husk is the coir pith. Coir pith is currently utilized as a medium for seedling nurseries, bedding plants, preparing blend supplies for aqua-farming, production of blossoms, vegetables, trees, bushes, manure receptacles, vertical farming, and packaging layer for mushrooms. As of now, coir pith stands apart as the eco-accommodating and more dependable swap for the sphagnum peat greenery, rock fleece, and sawdust. Coir pith-based items give a superb developing and pulling mechanism for hydroponics or container-based plant development. Wide variations in the C: N ratio of coir pith from 58:1 to 112:1 have been accounted for by different scientists. Coir pith obtained from fully mature nuts has higher amounts of lignin and cellulose and a lesser amount of water-soluble salts compared to younger nuts. The coir pith is used as a medium of mat nursery for the germination of paddy seeds and seedling production. Using coir pith affected seed germination and seedling growth and had the least values for germination, growth, and physiological parameters in nursery plants by mat nursery. The application of raw coir pith in nursery preparation may inhibit plant growth due to the wide C: N ratio, polyphenols, and phenolic acids that make plants develop toxic yellowing phytotoxic symptoms.



## METHOD OF COMPOSTING OF COIR PITH (CONVENTIONAL PROCESS)

### Composted coir pith preparation

The Coir pith was composted by inoculating a proprietary bio-formulation, such as PITH PLUS (*Pleurotus sajor caju*), and enriched with urea showed a definite reduction in lignin and cellulose contents with an increase in total nitrogen and other nutrient elements after 30 days.

### Method of composting

- Spread uniformly 100 kg coir pith in an area of 5m x 3m
- Apply one packet of Pith plus (400gm) uniformly over it
- Cover with 100 kg coir pith and apply 1 kg urea uniformly over it.
- Spread 100 kg coir pith again
- Repeat the sandwiching process
- Moisten the heap by sprinkling 25 buckets (approx) of water daily.
- Allow the heap to decompose for 30 days
- One ton Coir Pith + 2kg Pith plus + 5 kg Urea (200 % Moisture with 30 days)

Coir heaped up as a pile can emit a lot of heat at the center as the stages of the composting process gradually increase and decrease by perforated PVC pipes are connected vertically. About 25 cm of the vertical pipes protrude above the top surface of the multi-layered heap of the coir pit. (Fig 1). After composting coir pith is reduced in the C: N ratio and used for soilless cultivation.



**Fig.1 Conventional method of coir pith composting (Source: Google)**

### Grow Bag

A grow bag is a portable and versatile gardening container that provides plants with the space they need to grow while offering optimal drainage. It's essential to choose the right bag size and material, as it directly impacts the health and growth of your plants.

### **Selecting the Perfect Grow Bag**

When it comes to choosing a grow bag, consider factors such as material, size, and durability. Optimum for grow bags made from a breathable and sturdy fabric that allows for proper aeration and prevents waterlogging. The size of the grow bag should accommodate the specific plants you plan to grow.

#### **PREPARING THE GROW BAG**

##### **Choosing the Right Potting Mix:**

The success of your plants largely depends on the quality of the potting mix you use. A well-draining mix with a blend of compost, perlite, and peat moss is ideal.

##### **1. Moistening the Potting Mix:**

Before filling the grow bag, moisten the potting mix thoroughly. This ensures that the mix is evenly moist and ready to nurture your plants.

##### **2. Filling the Grow Bag:**

Gently fill the grow bag with the moistened potting mix, leaving about an inch or two from the top. This space prevents spillage when you water your plants.

#### **PLANTING AND CARING FOR YOUR GROW BAG GARDEN**

##### **1. Choosing Plants:**

Select plants that are suitable for growing bags. Herbs, vegetables, and even some flowers thrive in this environment. Consider the growing requirements and potential size of each plant.

##### **2. Planting:**

Make small holes in the grow bag to accommodate the plants. Carefully transplant your seedlings, ensuring they are at the same depth as they were in their original containers.

##### **3. Watering:**

Regular watering is crucial. The fabric of the grow bag allows water to evaporate more quickly than traditional pots, so monitor the moisture level closely. Water when the top inch of the soil feels dry.

##### **3. Feeding:**

Since the potting mix in grow bags doesn't contain as many nutrients as garden soil, you'll need to supplement it with fertilizers. Opt for slow-release granules or liquid fertilizers, following the recommended dosage.



#### 4. Support and Pruning:

Some plants might require support as they grow. Use stakes or cages to prevent them from bending or breaking. Regularly prune your plants to encourage healthy growth.

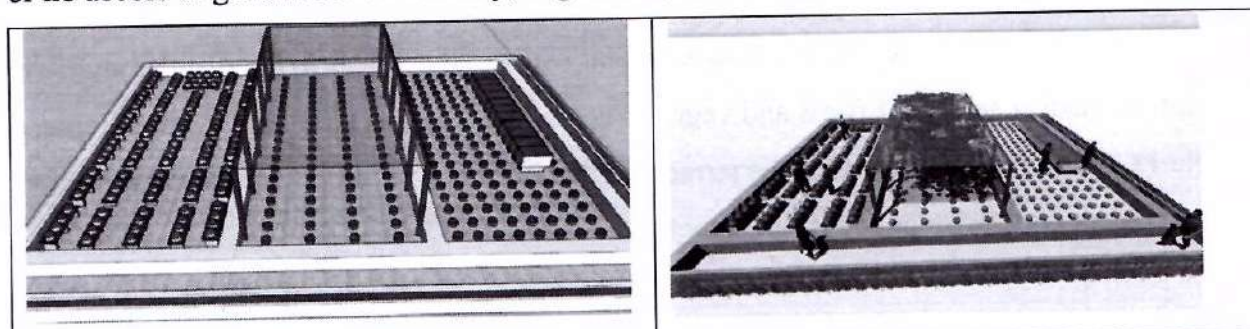
#### Pot / Growbag mixture

Mixing composted coir pith with less soil will reduce the amount of soil weight and is good for vegetables. Put a handful of Neem cake with coir pith, it will help to protect against attacks from soil-based pests and diseases.

It's better to avoid chemical fertilizers in grow bags if you are placing the same on a rooftop/terrace. If it is possible to use the same for filling grow bags with Dried Leafs, Neem Cake, and Vermi Compost all mix well and fill in grow bags. don't use pressure to fill the mixture don't fulfill it. just fill 3/4 portion of grow bags, if you fill it's difficult to apply water and apply organic fertilizers later.

#### Terrace garden

The art of growing flower or vegetable crops on a house's terrace rather than on normal ground is known as terrace gardening. Terrace gardening is a type of gardening that involves growing plants in containers or bags, on a balcony, rooftop, or other outdoor space with limited or no access to ground soil. Normally, vegetables, flowers, greens and herbs, etc.,



**Fig. 2. 3D view of the plan of the terrace garden in soilless agriculture (Source: Google)**

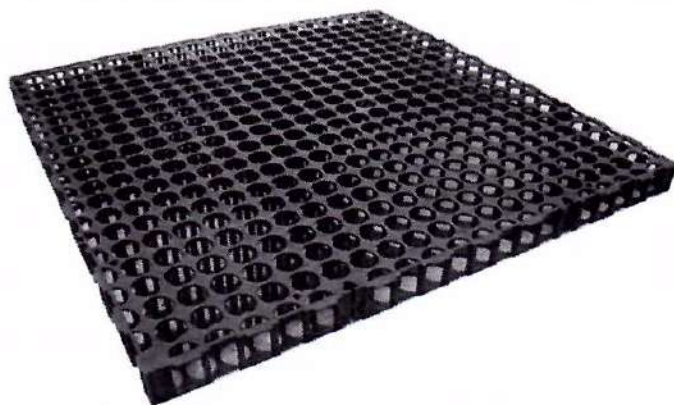


**Fig. 3. Common view of the terrace garden in soilless agriculture (Source: Google)**



In the terrace garden, one meter of every side for a walking path and a fixed container for leafy vegetable production. The center of the terrace is to raise the iron rod in a panthal shape for use to raise the panthal crops. Both right and left spaces are used for vegetable cultivation in rows wise fixed according to the needs of the family. Every grow bag in the bottom is used for the Drainage Cell Mats for drainage (Fig 2 and 3).

Drain cell mats provide efficient drainage by allowing excess water to flow through the cells and away from the surface. This prevents waterlogging, which can lead to root rot and other plant health issues Fig 4.



**Fig. 4. Dry cell mat (Source: Google)**

#### **Planning the plating**

Nutrition terrace gardens enhance dietary diversity by providing micronutrients through a constant supply of fruits and vegetables sufficient to meet the family's requirements (Table 1). Accordingly, to plan for the terrace garden.

**Table 1: Colour Classifications and Health Benefits**

<b>Colors</b>	<b>Fruits &amp; Vegetables</b>	<b>Phytochemicals Vitamins &amp; Minerals</b>	<b>Health Benefits</b>
<b>Green</b>	<b>Fruits:</b> Green Grapes, Limes, Green Pears, Kiwi, Chayote, Honeydew, Avocado, Green Apples <b>Vegetables:</b> Asparagus, Broccoli, Brussels Sprouts, Celery, Greens, Collard Greens, Muster	Lutein, Glucosinolates, Folate, Isothiocyanates, Vitamin K, folic acid, potassium, chlorophyll, Vitamin C, Iron	Prevent muscular degeneration, boost immune system, maintain healthy bones and teeth.

	Greens, Turnip Greens, Spinach, Green Beans, Green Peppers, Cabbage, Zucchini, Packaged Salad Bags, Lettuce, Okra, Cucumbers		
<b>Red Blue Purple</b>	<b>Fruits:</b> Cherries, Strawberries, Grapefruit, Watermelon, Blueberries, Plums, Red Grapes, Black Grapes, Red Apples <b>Vegetables:</b> Beets, Radish, Tomatoes, Red Peppers, Red Onions	Lycopene, Anthocyanins, Calcium, Vitamin D, Flavonoids, Resveratrol, Vitamin C, Folate	Reduce tumor growth and cancer and stroke risk, Promotes memory function, healthy aging, heart, and prostate health.
<b>Yellow Orange</b>	<b>Fruits:</b> Apricots, Cantaloupe, Pineapple, Yellow Apples, Oranges, Tangerines, Peaches, Mango, Nectarines, Lemons <b>Vegetables:</b> Carrots, Corn, Pumpkin, Yams, Squash, Yellow Peppers	Alpha-Carotene, Beta-Carotene, Vitamin A, Vitamin C, folate	Promote vision and immune system; reduce cancer risk, and heart disease.
<b>White</b>	<b>Fruits:</b> Bananas, Coconuts, Bosc Pears <b>Vegetables:</b> Plantain, Cauliflower, White Onions, Mushrooms, Turnips, Russet Potatoes, Idaho Potatoes, Jicama, Yuca	Allyl Sulfides, Allicin, Potassium, Selenium (Mushrooms, Nuts)	Prevent certain cancers; maintain cholesterol levels.

### ADVANTAGES OF TERRACE GARDEN IN SOILLESS CULTIVATION

- Consume nutritious vegetables and greens regularly.
- Vegetables and greens are produced naturally.



- The cost of vegetables is saved.
- Small work in the garden such as weeding, and planting in leisure is also exercise for our bodies.
- It gives a green look and takes us on a happy life.
- Increases sloping field farmability and production.
- Improves rainwater gathering and contributes to water conservation by slowing and reducing water run-off.
- Reduces rill forms, which prevents soil erosion.
- Soil conservation is aided.
- Sedimentation and water pollution are reduced.

#### **DISADVANTAGES OF TERRACE GARDEN IN SOILLESS CULTIVATION**

- Water leaking from the terrace might be a menace.
- Stagnation of water and soil deposition might be an issue.
- Controlling rats, mice, frogs, and birds becomes challenging.
- A lack of knowledge regarding pest and disease management could be a problem.

Some of the pictures from the terrace garden soilless cultivation (Source: Google)



**Turmeric**



**Tomato**



**Beans**



**Brinjal, Raddish and maize**

Soilless farming is categorized into two widely used methods: open farming culture and closed farming culture.

Open farming culture involves the utilization of diluted nutrient solutions during each irrigation cycle, with plants absorbing these solutions typically through a dripping system. This method ensures the synchronization of adequate nutrient levels within the root zone. **VARIOUS TECHNIQUES WITHIN OPEN SOILLESS CULTURE ARE ELUCIDATED BELOW:**

**1. Root Dipping Technique:**

- Plants are cultivated in pots equipped with small holes at the base, filled with substrate medium like coconut fiber, and placed in containers containing nutrient solutions.
- A portion of the pots' lower section remains in close proximity to the nutrient medium, allowing only some roots to be partially submerged while others remain suspended in the air.



- This method offers a simple and cost-effective approach to cultivate small herbs or flowering plants.

## **2. Hanging Bag Technique:**

- Utilizes long cylindrical polythene bags closed at the lower end and connected to PVC pipes at the upper portion.
- These bags are suspended vertically above a nutrient supplement tank, with planting materials such as seeds or fruits placed in netted pots inserted into holes on the bags.
- A micro-sprinkler disperses the nutrient solution to the top of each hanging bag, ensuring uniform distribution inside.
- This technique is suitable for growing vegetables like lettuce, climbers, and small flowering plants.

## **3. Trench Method:**

- Involves growing small herbs and shrubs in trenches constructed using bricks or concrete blocks on or above ground.
- The inner linings of the trenches are covered with thick polythene sheets to prevent direct contact between the growth medium and the ground.
- Nutrient supplements and water are delivered through the dripping process, making this system suitable for various crops, including herbs and tall vine plants.

Closed farming culture, on the other hand, focuses on maintaining balanced and marked concentrations of nutrients for reuse. It encompasses both traditional and modern cultivation frameworks, with several techniques outlined below:

### **1. Hydroponics Technique:**

- Involves growing vegetables, herbs, climbers, and flowers using inert media such as coconut fiber or rock pieces.
- Plants are fed nutrient solutions containing all necessary minerals and nutrients, offering advantages like high yields, reduced pollution, and enhanced nutrient and water efficiency.

### **2. Nutrient Film Technique (NFT):**

- Developed in the 1960s by A. Cooper, this hydroponic system maintains a continuous supply of nutrient solution, with plant roots remaining in contact with the solution.

- Plants are cultivated inside containers with their roots hanging inside the nutrient medium, allowing for higher salinity tolerance compared to soil-based cultivation.

### 3. Aeroponic Technique:

- Represents an advanced form of hydroponic system where nutrient solution is sprayed to create a fine mist around the root system inside a chamber.
- Plants are grown using inert materials with holes, with their roots suspended in midair within the spraying box.
- This method maximizes space utilization, enabling the growth of plants per unit floor area compared to other systems, although improper nutrient spreading cycles may lead to rapid root drying and plant death.

## Potential Soil Less Culture Media

### 1. Fermented Organic Manure (FOM):

- Forged through the transformative alchemy of organic fermentation, FOM emerges as a product of bioconversion from substrates like compost, livestock excreta, or vegetal remnants.
- The fermentative crucible engenders the breakdown of intricate organic matrices into simpler molecular moieties, thereby augmenting the bioavailability of nutrients for plant assimilation.
- Infusing the growing medium with a profusion of beneficial microbial consortia, FOM engenders an enriched milieu conducive to the orchestration of nutrient cycling and the fortification of soil architecture.
- FOM instills an impetus towards bolstering soil fertility, augmenting water retention capacities, and ameliorating aeration dynamics, thereby instigating a salutary effect on root morphology and plant phenology.
- By obviating the exigency for synthetic fertilizers, FOM fosters the proliferation of sustainable agricultural paradigms, championing eco-centric cultivation methodologies.

### 2. Paddy Husk (Rice Husk):

- Hailing as the outer integument enshrouding rice kernels, paddy husk accrues during the milling process as a byproduct of agrarian praxis.



- Endowed with a diminutive mass and a superlative drainage prowess, paddy husk epitomizes an eminently manipulable medium amenable to facile handling and conveyance within hydroponic conduits.
- The pervasive presence of silica imparts a salutary tonic to plant physiology, fortifying resilience against pathological incursions and conferring an impregnable bastion against biotic adversities.
- Exhibiting a proclivity towards gradual decomposition, paddy husk proffers an enduring scaffold for plant sustenance within hydroponic and soilless precincts.
- Amenable to synergistic amalgamations with diverse substrates, paddy husk furnishes an avenue for the formulation of bespoke growing media tailored to the idiosyncratic exigencies of disparate botanical taxa.

### **3. Wood Wool (Excelsior):**

- Comprising attenuated filaments derived from the pulpy fibers of coniferous woods, wood wool epitomizes a biodegradable reservoir conducive to the exigencies of sustainable agrarian endeavors.
- Facilitating an unimpeded flux of atmospheric gases, wood wool instigates an aeration regime conducive to the unfettered proliferation of root systems, mitigating the specter of compaction-induced hypoxia.
- Proficient in the judicious retention and dissemination of moisture, wood wool engenders a modicum of hydric equilibrium, curtailing excessive transpiration and precluding the onset of inundation-related maladies.
- Whether deployed as a stand-alone substrate or assimilated into composite growth matrices, wood wool engenders a veritable edifice underpinning the imperatives of drainage enhancement and structural integrity augmentation.
- By virtue of its biocompatibility and innate ecological probity, wood wool emerges as a linchpin constituent within the repertoire of hydroponic substrates, enunciating a steadfast commitment towards sustainable cultivation modalities.

### **4. Bio-Stimulant:**

- Constituting a panoply of organic compounds and microbiological consortia, bio-stimulants epitomize agents propitious to the augmentation of plant growth and physiological fortitude through multifarious mechanistic pathways.
- Facilitating the expedited translocation and assimilation of nutrients, bio-stimulants elicit an exuberant response in terms of nutrient uptake, root elongation, stress resilience, and overall vegetal vigor.



- Deriving sustenance from the fecund bosom of nature, bio-stimulants draw upon an eclectic gamut of sources ranging from marine phycocolloids and humic substances to amino acids and symbiotic microorganisms.
- Orchestrating a symphony of symbiotic interactions between plants and edaphic microflora, bio-stimulants catalyze the proliferation of an affluent rhizospheric ecosystem, fostering the concomitant enhancement of nutrient cycling and soil fecundity.
- Prevalently harnessed within hydroponic contexts, bio-stimulants epitomize a quintessential adjunct to nutrient management protocols, facilitating the judicious optimization of nutrient assimilation dynamics and the concomitant amplification of crop yields within a sustainable ambit.

## KEY CHALLENGES AND CONSIDERATIONS IN HYDROPONICS

Hydroponics, an advanced method of soilless cultivation, boasts numerous advantages but also poses specific challenges and considerations necessitating strategic management for optimal outcomes. A nuanced understanding of these challenges is paramount for fine-tuning system performance and attaining maximal crop yields. Below delineates a comprehensive exposition on the challenges and considerations inherent in hydroponics:

1. **Capital Intensive Setup:** One of the foremost hurdles in hydroponics is the substantial initial investment requisite for system establishment. The hydroponic infrastructure, encompassing growth substrates, nutrient formulations, hydraulic systems, lighting apparatus, and environmental controls, entails considerable capital outlay. Growers must meticulously strategize to orchestrate a financially prudent setup aligning with their production objectives.
2. **Technical Acumen:** Hydroponic systems demand a sophisticated level of technical proficiency spanning system design, installation, and operational oversight. Growers necessitate a nuanced understanding of plant physiology, hydroponic methodologies, nutrient kinetics, and system maintenance protocols. Insufficient technical expertise may precipitate suboptimal growth conditions, nutrient imbalances, and diminished crop yields. Training initiatives and educational resources play an instrumental role in equipping growers with requisite competencies for efficacious hydroponic cultivation.
3. **Nutrient Optimization:** Precise nutrient management constitutes a pivotal facet of hydroponic cultivation to foster robust plant growth and vigor. Achieving harmonious equilibrium in nutrient concentrations, pH levels, and nutrient assimilation rates mandates vigilant monitoring and judicious adjustment. Over or under-provisioning of



nutrients can precipitate deficiencies or toxicities, compromising plant health and developmental trajectories. Routine assessments of water quality and nutrient solution composition are imperative for sustaining optimal nutrient regimes in hydroponic setups.

4. **Water Quality Assurance:** Water quality emerges as a critical determinant in hydroponic endeavors. The presence of contaminants such as pathogens, salts, heavy metals, and chemical residues imparts deleterious ramifications on plant vitality and operational efficacy. Growers must procure pristine water sources and implement rigorous filtration and sterilization modalities to confer pristine and safe water inputs to hydroponic systems. Ongoing surveillance of water quality metrics is indispensable for preempting potential adversities and safeguarding crop integrity.
5. **Pest and Pathogen Management:** Despite mitigating soil-borne disease risks, hydroponic systems remain susceptible to pest incursions and pathogenic infestations. Pathogens such as *Pythium*, *Fusarium*, and powdery mildew pose formidable threats in hydroponic milieus, especially under conducive conditions of warmth and humidity. Adherence to stringent sanitation practices, cultivation of disease-resistant cultivars, and adoption of integrated pest management (IPM) protocols constitute indispensable measures for forestalling and managing pest and pathogen proliferation within hydroponic frameworks.
6. **Environmental Optimization:** Precision modulation of environmental parameters constitutes a linchpin for efficacious hydroponic crop cultivation. Variables including temperature, humidity, light intensity, and air circulation exert profound influences on plant metabolic processes and developmental trajectories. Growers must invest in sophisticated climate control apparatuses encompassing heaters, fans, evaporative coolers, and artificial lighting systems to orchestrate a salubrious microclimate within hydroponic facilities. Real-time monitoring and fine-tuning of environmental parameters are instrumental in sustaining optimal growth conditions and maximizing crop yields.
7. **Sustainability Imperatives:** Sustainable resource stewardship emerges as an imperative facet in hydroponic operations. Mitigating energy consumption, curtailing water utilization, and abating waste generation accrue paramount importance in ameliorating environmental footprints and operational overheads. Implementation of energy-efficient illumination systems, adoption of water conservation and recycling

initiatives, and deployment of waste mitigation strategies are instrumental in advancing sustainability imperatives within hydroponic ecosystems.

8. **Regulatory Compliance Adherence:** Hydroponic practitioners are bound by regulatory strictures mandating adherence to stipulations pertaining to food safety, water quality standards, pesticide usage, and nutrient management protocols. Conformance to local, state, and federal statutes not only ensures product integrity and consumer safety but also bolsters market access and reputational capital. Growers must remain abreast of evolving regulatory landscapes and industry benchmarks to uphold compliance mandates and preempts potential sanctions or legal encumbrances.

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