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Popular Article

Aquaponics

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Abstract

Aquaponics is a sustainable method of food production that combines aquaculture and hydroponics to grow fish and crops without soil. It involves a harmonious cycle between the fish and plants. In this system, fish waste (ammonia) is utilized as a nutrient source for the plants, which act as a bio-filter by absorbing nitrate, a vital component for vegetation growth. The purified water is then returned to the fish enclosure to initiate the cycle anew. One notable advantage of aquaponics is its efficient water usage compared to traditional irrigation systems. Water conservation is achieved by continuously recycling water between the plant bed and the fish habitat. Unlike hydroponics, which relies on artificial methods, aquaponics employs the natural breakdown of fish waste to nourish plants. By using plants as a natural alternative to conventional filters, less monitoring of water quality is required.

Keywords: Nutrient film technique, aquaculture, hydroponics

Introduction

Aquaponics is an innovative agricultural system that combines fish farming (aquaculture) with soil-less plant cultivation (hydroponics) in a symbiotic environment. It creates a closed-loop cycle where fish waste is converted into nutrients for plants, which in turn purify the water for the fish. Aquaponics is resource-efficient, eliminates the need for synthetic fertilizers, and allows year-round cultivation regardless of climate. It has gained popularity as a sustainable solution for food production, particularly in areas with limited land or water resources. Aquaponics holds great potential for promoting food security and sustainable agriculture in the future.

Steps in aquaponics system

In aquaponics, there are several key steps involved in setting up and operating a system:

System Design: Determine the scale, location, and layout of the aquaponics system based on available space, desired fish and plant species, and production goals.

Tank Setup: Install a fish tank or tanks to house the aquatic organisms. The tank should be adequately sized, insulated, and equipped with a filtration system to maintain water quality.

Grow Bed Construction: Create grow beds above the fish tank, which serve as containers for the plants. The beds are filled with a growth medium like clay pellets or gravel, allowing plant roots to access nutrient-rich water.

Plumbing and Water Circulation: Set up a pump and plumbing system to circulate water from the fish tank to the grow beds and back. This ensures a continuous flow of water, delivering nutrients to the plants and oxygen to the fish.

Biological Filtration: Introduce beneficial bacteria into the system to convert fish waste (ammonia) into plant-available nutrients (nitrates). Establishing a healthy bacterial colony is crucial for water purification and nutrient cycling.

Plant Selection and Cultivation: Choose plant species that thrive in aquaponics, such as leafy greens, herbs, and some fruiting plants. Plant seedlings or seeds in the grow beds, allowing their roots to absorb nutrients from the circulating water.

Fish Feeding and Monitoring: Feed the fish a balanced diet according to their species-specific needs. Monitor water quality parameters regularly, including temperature, pH, ammonia, and nitrate levels, to ensure a healthy environment for the fish and plants.

Maintenance and Troubleshooting: Perform routine maintenance tasks like system cleaning, pruning plants, and checking equipment functionality. Address any issues that arise, such as nutrient deficiencies, pests, or diseases, to maintain system performance.

Harvesting and Utilization: Harvest mature plants for consumption or sale as they grow. Fish can also be harvested when they reach the desired size. Employ proper processing and handling techniques to maintain quality and safety.

By following these steps, aquaponics systems can provide a sustainable and efficient method of food production, combining fish and plant cultivation in a mutually beneficial manner.

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Types of aquaponics

*Media based aquaponics system
*Nutrient film technique
* Raft system
*Vertical aquaponics system

Media based aquaponics system

The media-based system is a small-scale aquaponics setup that offers simplicity, efficiency, and a compact design at a low initial cost. In this system, a bed is created using various grow media such as gravel, lava rock, or clay pebbles to support crop planting. Periodically, the grow bed is flooded with water from the fish tank using a siphon, providing essential nutrients to the plants. The water is then drained back into the fish tank, initiating a new cycle. All waste materials are broken down within the grow bed. However, due to its limited growing space, this type of system yields lower production compared to other systems.

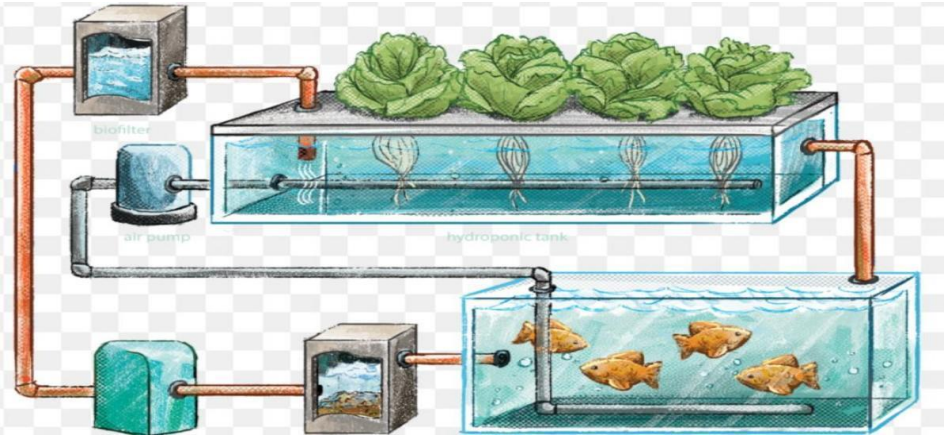

Figure 1. Aquaponics system

Nutrient film technique

The nutrient film technique, which is widely employed in commercial aquaponics, is a hydroponic growing method that offers a straightforward yet efficient design suitable for various environments. In this technique, plants are cultivated within elongated and narrow channels. A constant flow of a thin water film is directed down each channel, ensuring a consistent supply of water, nutrients, and oxygen to the plant roots. Similar to the raft system, the water circulates from the fish tank through filtration components and NFT channels where the plants are situated, before returning back to the fish tank.

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Raft system

The raft system, also referred to as deep water culture, is recognized as a highly efficient aquaponics system design. It is particularly suitable for large-scale operations due to its ability to facilitate mass production. In this system, nutrient-rich water circulates through lengthy canals, typically at a depth of 20 cm, supporting a floating raft on top. The plants are cultivated on raft boards, which are equipped with holes created by net pots. As the plants extend their roots into the oxygenated water enriched with supplements, they absorb and utilize oxygen and nutrients for growth. The nutrient-laden water consistently flows from the fish tank through the filtration process. It is common for the raft tank to be separate from the fish tank.

Vertical aquaponics system

An aquaponics system known as vertical gardening eliminates the need for soil by cultivating vegetables in columns positioned above a fish tank. This method of gardening and fish cultivation is both water-efficient and space-saving. By utilizing vertical space, it enables the production of double the crop yield within the same area. In a vertical aquaponics system, a compact pump transports nutrient-rich water from the fish tank to the uppermost part of the vertical aquaponics towers. As the water descends through the plants' roots, it simultaneously absorbs oxygen from the surrounding air, ultimately returning to the fish tank.

Benefits of aquaponics

Aquaponics enables simultaneous growth of fish and vegetables or plants without the need for fertilizers. By harnessing the rich nutrients provided by the fish, fertilizers become unnecessary. In this system, less water is required for crop cultivation. Traditional pesticides or chemicals cannot be employed as they would harm the fish, leading to the production of healthier, organic vegetables. The fast growth of plants is facilitated by the highly nutritious substances derived from fish waste. Furthermore, the production of both plants and fish can be carried out in a controlled temperature environment.

Conclusion

The aquaponics system stands out as the optimal solution for feeding the world due to its remarkable efficiency and sustainability. It offers a user-friendly experience while consuming significantly less water compared to traditional farming and genetically modified products. The food

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grown within an aquaponics system is abundant in nutrients, without posing any potential risks to both the environment and the health of consumers, unlike genetically modified alternatives.

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