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Organic Aquaponics –A Sustainable Approach

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ARTICLE ID: 029

Introduction

Aquaponics is plant-fish collaboration, and the name is derived from the terms Aquaculture -Practise of raising fish in a recirculating system. Ponos - Greek for growing plants with or without medium. Most people associate plant cultivation with hydroponics since both employ nutrient-rich water and soil-free medium.

Aquaponics is a word that first appeared in the 1970s. The Aztecs' development of a system of agricultural islands known as chinampas, according to researchers, was the earliest kind of aquaponics for agricultural reasons. Thechinampas of Mexico and integrated rice paddy systems across Asia are ancient antecedents for integrated aquaculture.

Why Aquaponics is considered sustainable:

- It just uses a small amount of water, around 10% of soil growing water.
- There's no need to buy, store, or apply fertiliser.
- There are no soil-borne illnesses, no tilling, and no weeds in this garden.
- Produce and protein are two food items that may be grown together.
- Fish stocking density is high, and crop production is high.
- There is no waste - hydroponics waste solution, aquaculture waste fish solids — all trash is utilised in aquaponics.
- There are no pesticides or herbicides used; only fish fertiliser is used.
- Food security may be achieved by growing your own food year-round, inside.
- Works in a draught or in areas where the soil quality is poor.
- Local food production boosts the local economy while lowering food transportation costs.

How does it Works:

Aquaponics is based on the idea of repurposing waste. The following diagram depicts the step-by-step operation of aquaponics:

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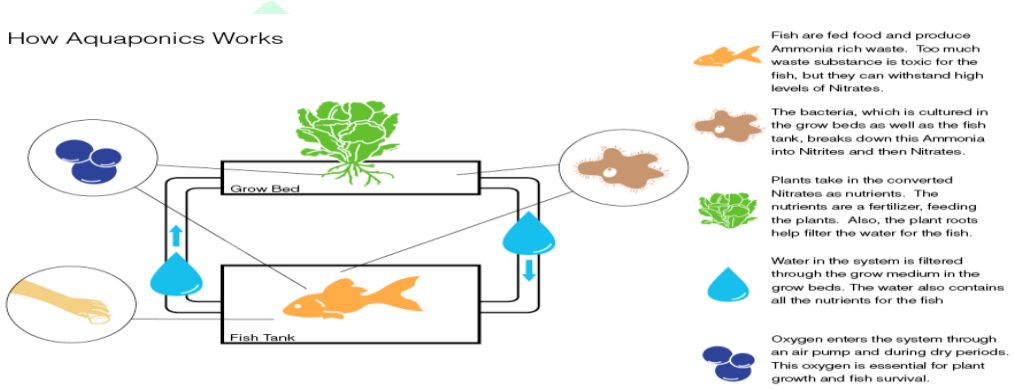
- In aquaponic tanks, fish produce waste in the form of ammonia, which is hazardous to fish at high quantities and must be eliminated from the system. The ammonia accumulation is further aided by algae and leftover fish feed.
- The nitrification process breaks down ammonia into nitrate (a more accessible form of nitrogen for plants) with the aid of bacteria (Nitrosomonas and Nitrobacter).
- Plant roots absorb nitrates from the water, effectively cleaning it before it is re-circulated into the fish tanks.



Components of aquaponics:

A fish tank (aquaculture), a biofilter (for nitrification), and a grow bed make up a typical aquaponic system (hydroponics). Aquaponic systems usually contain numerous components, despite being largely made up of these.Each of these is summarised below..

- A fish tank is a container in which fish dwell.
- To remove solid waste from culture water, use a mechanical filter/clarifier.
- Biofilter **-:** A biofilter is a device that allows nitrifying bacteria to grow on the surface of particle media with a high surface-to-volume ratio.
- The plants are cultivated in the grow bed.
- Pumps for water and air: to circulate water throughout the system and provide dissolved oxygen to all sections of the fish tank.
- The lowest point in the system, where water flows to and is pumped back to the fish tank, is the sump tank.

Types of aquaponicsystems:

The aquaponic systems have been divided into three categories based on the type of grow bed used.

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Media-filled bed system:

- This technique is sometimes referred to as a gravel bed system.
- Its basic design makes it ideal for small-scale aquaponics since it saves space, is inexpensive, and is suited for novices.
- The plant is rooted in coarse gravel or aggregate medium in this method.
- Bacteria develop on the medium and convert ammonia produced by the fish to nitrate, which is then taken from the water and given back to the fish in a healthy state.
- Because rocks function as biological and solids filters, no mechanical or biological filtering is necessary.

Deep water culture system:

The raft, float, deep channel, or deep flow system are all terms used to describe this system. Water circulation is continuous from the fish tank to raft tank through filtration components and then back to fish tank. The huge amount of water in the raft tank offers a buffer for the fish, which is the most significant advantage of this raft system. This is the most usual method for big commercial aquaponics systems that cultivate a single leafy crop (lettuce, salad leaves or basil).

Nutrient Film Technique:

- Growing plants in plastic pipes spread out horizontally with a stream of nutrient-rich aquaponic water running through them is the nutrient film technique.
- During filter cleaning, this approach also results in water and nutritional loss, and is best suited to green vegetables and fish.
- Adler et al. (2000) demonstrated that the NFT system for generating rainbow trout (Oncorhynchus mykiss) and lettuce (Lactucasativa) was far more efficient than growing the plant and fish individually in terms of phosphorus rate recovery.

Media-Based Growbed

Plants are grown in media such as gravel, hydroton, lava rock, vermiculite, sponges, and perlite, to maximise exposure to both air and nutrients. Media beds may be "trickle fed" nutrient solution or subjected to periodic flooding and drainage ("ebb and flow"). The media beds also serve as biological filters.

Recommended fishes and plants grown in aquaponics:

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In aquaponic systems, fish that are generally warm and can endure crowding will thrive. Tilapia is one of the most often grown fish species in such systems. Catfish, largemouth bass, asian sea bass, rainbow trout, salmon, common carp, koi carp, silver perch, barramundi, jade perch are some of the other fish species suitable for this type of farming.

Over 150 different crops, herbs, flowers, and tiny trees have been successfully produced in aquaponic systems, including research, household, and commercial units, to far. The density of fish in tanks and the nutritional content of fish excrement determine plant performance in any aquaponics system. Leafy green plants and herbs like lettuce, spinach, basil, and mint do particularly well in a fish-powered environment. Bell peppers, beans, peas, cucumbers, and tomatoes are among the vegetables that may be grown.

Advantages:

- Water use is significantly reduced in aquaponics units compared to traditional soil-based farming since the water is recycled. Aquaponics, according to various studies, uses up to 90% less water. Aquaponics' one-of-a-kind characteristic has the potential to allow production in areas where water is scarce.
- Because the plants are naturally fed by nutrients produced from fish faeces (through the nitrification process), artificial fertiliser is not required to develop the plants.
- Greater agricultural yield: In an aquaponics unit, plant growth is claimed to be faster, resulting in a higher crop output.
- Use non-arable land: This farming method is adaptable to a wide range of geographical and climatic locations, allowing for a wide range of adoption. Aquaponics may thrive in dry climates, high-salinity soils, and deteriorated land (as a result of discriminate use of fertilisers or erosion or mining).
- Biosecurity: Diseases and parasites can't enter into aquaponics farming units since they're completely closed and controlled and don't use any chemicals, medicines, or antibiotics.
- Ease of implementation: Aquaponic farms may be set up in a green house, rooftop, or backyard in a small amount of space and do not require arduous chores like soil-based agriculture.

Disadvantages

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- High initial investment: Setting up an aquaponic unit may be costly because it necessitates the purchase of a tank, pumps (both air and water), tubing, and a grow bed.
- Continual power supply: A steady supply of power is essential for recycling water and maintaining a suitable oxygen level in the tank.
- Plant choices are limited: Large crops are difficult to cultivate. Furthermore, root crops such as potatoes and carrots are not permitted to be cultivated.
- Technical knowledge is required: Because both plants and fish are important components of an aquaponic unit, competence and knowledge in both agriculture and aquaculture are required for the farm's success.
- Unsustainable fish feed costs: The high cost of fish feed might render the system unsustainable financially. Once the system is up and running, the feed cost may become the most expensive component of the overall system.

Conclusion

Aquaponics can be a promising approach for ensuring nutritional security in a sustainable way, since it has the capacity to generate large yields with minimum additional nutrients, while also substantially decreasing nutrient outflow and water waste from aquaculture. Owing to depletion of natural resources, the continual loss of arable land due to a variety of reasons, and continued climate change, it is now unavoidable to investigate sustainable farming techniques.

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