

Aquaponics: Sustainable farming method in the fight against hunger

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Aquaponics is a closed-loop system, in which the waste water produced from a store tank of fish is being utilised as fertiliser to feed the vegetation bed. In turn, the plant life filters the liquid through its roots and then the cleaned water is again utilised in the aquarium. So, this is a symbiotic and integrated system in which both the systems (aquaculture and hydroponics) are benefitted with each other and eliminates the drawbacks of each. The third participants are microbes (nitrifying bacteria). These bacteria convert ammonia from the fish waste first into nitrites and then into nitrates. Nitrates are the form of nitrogen that plants can uptake and use to grow. The solid waste excreted by fish is converted into vermicompost to use it as food for the plants.

Aquaponics is a natural and sustainable practice that mimics processes in lakes, ponds, rivers and other waterways. The only input that we have to provide into this system is fish food. Fish will eat food and excrete waste which is then converted by nitrifying bacteria into the form that the plants can use. In return, the plants help to purify the water. You cannot use herbicides, pesticides or other harsh chemicals in an aquaponics system, making the fish and plants healthful and safe to eat.

Problems with traditional farming methods include:

- Pesticide and artificial nutrient usage.
- Weeds, pests and soil-borne insects.
- Intensive land, labour and capital requirements.
- Knowledge required to know when to water, when and how to fertilise, and to assess the composition and condition of the soil.
- Transport and logistical demands - traditional farms are often located thousands of miles from where the food is consumed.

Aquaponics can alleviate some of these shortcomings:

- Aquaponics mainly depends on the continuous recycling of nutrient-rich water between crop compartments. In this farming system, there is no toxic run-off from either hydroponics or aquaculture.
- Aquaponics uses a much lower amount of water in comparison to the traditional soil-based culture practices.
- It is an environmentally friendly approach. So, the use of chemicals such as pesticides or herbicides is avoided.

Gardening chores are cut down dramatically or eliminated. The aquaponics grower is able to focus on the enjoyable tasks of feeding the fish and tending to and harvesting the plants.

- Aquaponic systems can be put anywhere in a greenhouse, basement, living room or even outside. By using grow-lighting, space can become a productive garden.
- Aquaponics is a farming method that is an efficient use of space. A farmer having less space can earn more by using this farming method.

Methods of aquaponics widely in use

Deep water culture

Deep water culture or raft based growing method uses a foam raft that is floating in a channel filled with fish effluent that has been filtered to remove solid wastes. Plants are placed in holes in the raft and the roots hang freely in the water. This method is most appropriate for growing salad greens and other fast growing, relatively low-nutrient plants. It is also most commonly used in larger commercial-scale systems.

Media-based aquaponics

Media growing involves growing plants in inert planting media such as expanded clay pellets or shale. The media provides both the biological filtration (conversion of ammonia to nitrates) and mechanical filtration (removal of solid wastes) in the same system. Media based systems are great for home and hobby scale systems so you can grow a wide variety of crops. In particular, large fruiting plants do really well in addition to leafy greens, herbs and other varieties.

Nutrient film technique (NFT)

NFT systems work by flowing nutrient-rich water through a narrow trough, such as a PVC pipe. Plants are placed in holes drilled in this pipe, and the roots dangle freely in this stream of water. This method of growing works very well for plants that need little support, such as strawberries (pictured) and other herbs. NFT is also a great way to utilise unused space because they can be hung from ceilings above other growing areas.

Vertical aquaponics

One of the greatest aspects of aquaponics is its ability to grow an incredible amount of food in a very small area. No method does this better than vertical aquaponics. Plants are stacked on top of each other in tower systems. Water flows in through the top of the tower, and flows through a wicking material that the plants roots absorb water and nutrients from. The water then falls into a trough or directly into the fish tank. This form of agriculture makes the most of each square foot of space, and works very well with leafy greens, strawberries, and other crops that do not require support to grow.

Components of an aquaponic system

Aquaponics consists of two main parts i.e., aquaculture (raising aquatic animals) and the hydroponics (growing plants). The nutrients released in fish wastes are toxic to aquatic animals but also contains the essential nutrients for the plant growth. Although consisting primarily of these two parts, aquaponics systems are usually grouped into several components or subsystems responsible for the effective removal of solid wastes, for adding bases to neutralise acids, or for maintaining water oxygenation. Typical components include:

- Rearing tank: Tanks for raising and feeding the fish.
- Settling basin: Unit for catching uneaten food and detached biofilms and for settling out fine particulates.
- Biofilter: To grow nitrifying bacteria for the conversion of ammonia into nitrates, which are usable by the plants.
- Hydroponics subsystem: the portion of the system where plants are grown by absorbing excess nutrients from the water.
- Sump: the lowest point in the system where the water flows to and from which it is pumped back to the rearing tanks.
- Make sure to properly feed the fish for their survival and growth as depletion of fish stock makes this cultivation system impossible.
- Constant supply of food input is required to the fish to get regular fish waste for using it as feed for your plants.
- Provide proper aeration to your plants and fish is essential. All the organisms (plants, fish and bacteria) in the system need oxygen for their survival and performing their function efficiently.
- Select plants having similar water condition needs as the fish and this will result in greater success.
- Remove some excess fish waste when necessary because too much can harm the health of the fish (water quality should be monitored to maintain acceptable parameters).
- Keep an eye on the level of pH because it is crucial for both the fish and garden.
- Fish tanks should be made of glass or food grade plastic.
- Avoid using any pesticide other than organic, or any other substances that can and will harm the fish or the beneficial bacteria.

Depending on the sophistication and cost of the aquaponics system, the units for solids removal, biofiltration, and/or the hydroponics subsystem may be combined into one unit or subsystem, which prevents the water from flowing directly from the aquaculture part of the system to the hydroponics part. By utilising gravel or sand as plant supporting medium, solids are captured and the medium has enough surface area for fixed-film nitrification. By combining both biofiltration and hydroponics, it allows the aquaponics to eliminate the need for an expensive, separate biofilter.

Selection of vegetable to grow in aquaponics

- The fish and plants for an aquaponic system should have similar needs for temperature and pH. Warm, fresh water fish and leafy crops, such as lettuce, greens and herbs will do the best.
- In a small aquaponic based garden, you can grow vegetables that do not need heavy nutrient input. Lettuce, kale, watercress, arugula, decorative flowers, mint, herbs, okras, spring onions and leek, radishes, spinach and other small vegetables.
- Beans, broccoli, cabbage, cauliflower, cucumbers and tomatoes can require more nutrition and a well-stocked or more advanced aquaponic system.
- Avoid growing plants that need acidic or alkaline water, because those levels of pH can definitely harm the fish.

Tips for setting up of an aquaponic garden

- Start from a small garden. After that go for the bigger ones.
- As a backup, keep different power sources because in an aquaponic system, it is vital to keep the water flowing and the oxygen pumps on.

Conclusion

Aquaculture and its next-generation evolution, aquaponics, is one answer to our need for a more sustainable food supply. Aquaponics is a unique system that uses the waste products from fish production to supply nutrients to growing plants. The water, which has been cleansed by the growing plants, is then recirculated back to the fish. It requires around one tenth of the water needed for conventional crop production. This allows for aquaponic production of both crops and fish in areas where there is a scarcity of water or fertile land.