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Assembling a Small Scale Aquaponics System

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An Aquaponics is the integration of traditional aquaculture with hydroponics. Commercial aquaponics uses methods and equipment from both the hydroponics and aquaculture industries. Effluents from aquatic animals are used by plants as food. In the process, the plants purify water for the aquatic animals. The fish waste provides an organic food source for the plants and the plants act as a natural filter. This nitrogen cycle is at the heart of aquaponics.

In hydroponics, special nutrient solutions are have to be constantly introduced for the plants. The resulting salt residues regularly flushed out of the unit. In aquaculture, large amounts of nitrogenous waste are generated by the fish and they have to be removed from the tanks as fast as possible.

When the nutrient-rich wastewater from the aquaculture tanks is fed to the plants and plants utilize the nitrogenous waste of fish, effectively cleaning up the water, which can then be recycled**.** Commercial aquaponics production exists primarily in controlled environments, such as greenhouses or outdoor locations with favourable climates, using methods and equipment that draw from both the hydroponics and aquaculture industries.

Location for Your Aquaponics Setup

- The plants should be kept where it can receive at least 5-6 hours of direct sunlight. It ensures plant growth and good yield.
- The fish tank should be located away from sunlight because light exposure may result in the growth of green algae in the fish tank.
- Grow floating plants like water lettuce or Eichornia in the water so that they shield the water. You can even have some foam rafts with edible plants floating in the tank.
- Avoid keeping the system under trees that drop flowers or leaves.
- Some plants may contain toxic chemicals that can be harmful to the fish.

Parts of an Aquaponics system

A commercial Aquaponics system includes electric pump moves nutrient-rich water from the fish tank through a solids filter to remove particles the plants above cannot absorb. The water then provides nutrients for the plants and is cleansed before returning to the fish tank.

Aquaponics consists of two main parts, with the aquaculture part for raising fish and the hydroponics part for growing plants. The effluent-rich water becomes toxic to the aquatic animal in high concentrations but this contains nutrients essential for plant growth.
Typical components include:

- Rearing tank: the tanks for raising and feeding the fish;
- Settling basin: a unit for catching uneaten food and detached biofilms, and for settling out fine particulates;
- Bio filter: a place where the nitrification bacteria can grow and convert ammonia into nitrates, which are usable by the plants;[14]
- 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.

Grow bed - commonly used media

- **Crushed rock –** Any locally available crushed rock should do, but some rocks that have high lime content can raise the pH of the system. If testing with alcohol produces a fizzy reaction, it is better avoided.
- **River gravel –** If you can find river gravel of the right particulate size, it is a great but inexpensive option.
- **Expanded clay pellets –** This hydroponics staple has the advantage of being extremely light and porous. But it can be prohibitively expensive when you intend to make large grow beds.
- **Metal stones**

Preparation of Grow bed

Prepare the grow bed by putting 3/16 inch drain holes spaced 2 inches apart on the bottom of the bed. One hole will need to be larger to accommodate the pump tubing from the tank. The grow bed should be larger than the tank. Attach the pump to the fish tank on the side of the tank by using suction cups or on a flat rock. Make holes in the feed tube. The tube from the pump should go up through the hole into the grow bed, letting the line play out across the bottom of the grow bed. Secure the end of the tube with a clip to block it. Now, fill the grow bed with expanded clay which will be your growing medium

Types of hydroponic system

Plants roots immersed in the nutrient-rich effluent water. They filter out the ammonia that is toxic to the fish. After the water has passed through the hydroponic subsystem, it is cleaned and oxygenated, and can return to the aquaculture vessels. This cycle is continuous.

1. **Media-based aquaponics system**

The plants are cultivated in grow beds filled media. This is the most popular method, since plants of almost any type or size can be grown in the same bed. Small-scale farmers and home gardeners wishing to grow a variety of vegetables generally prefer this method.

2. Raft-based DW Culture

The plants grow on floating rafts directly placed in the fish tank. The rafts may not support heavier plants. So small plants like leafy greens and herbs uses this method

3. Nutrient film technique

The fish tank water is channeled in a thin film into gutters in which small plants are grown.

4. Hybrid aquaponics

It combines the media-based and raft-based systems. The water from the tank is first passed through beds filled with media and then diverted into channels housing raft planting.

5. Continuous flow system

In this system, a continuous flow from the fish tank to the grow beds is maintained with the help of a small water pump. The filtered water dripping down from the grow bed is directed to the fish tank.

6. Flood and Drain system

The pump is worked to flood the grow beds for a fixed amount of time and drain the water. However, the media is never allowed to dry out completely because it can affect the microbial population. It is the most efficient aquaponics system for a home gardener

Importance of Aquaponics

- Miserly water use - the water is used very efficiently to grow two crops - fish & plants
- Zero environmental impact - no nutrient-rich waste-water discharge, the fish food is used to its maximum potential (to grow fish & plants)
- Two crops from the one input - the fish feed entering the system supports the growth of both fish and plants
- Small footprint/high density - because of their compact nature, facilities may be located very close to the end users

Troubleshooting

- Pests in the grow bed – Pests such as slugs and worms can be expelled by flooding the grow bed .

- Algal bloom – It is usually seen before the system develops sufficient microbial load to handle the nutrients in the water. Cut down fish food until it clears.
- Algal growth on the sides if the tank – Too much light exposure causes green algae to grow. Place the fish tank away from the sun or cover it with dark fabric.
- Low water levels – Water loss through direct evaporation and transpiration by plants necessitate occasional topping up. You may need to do it more often when the weather is warm and windy.
- Nutritional deficiencies – It is rarely seen in an aquaponics system. Seaweed extract can be used as a general purpose fertilizer.

Benefits of aquaponics

- We can grow any time of year, in any weather, anywhere on the planet.
- Because aquaponics recycles the water in the system, we can grow in droughts and areas with little water.
- Fewer pests to deal with since we are growing indoors.
- There's no weeding!
- Plants Grows Twice As Fast! Due to the naturally fortified water from the fish.
- For the commercial farmer, aquaponics produces two streams of income, fish and veggies, rather than just one.
- Our aquaponics farm does NOT require farmland with fertile soil, or even land with soil; aquaponics can be done just as successfully on sand, gravel, or rocky surfaces, which could never be used as conventional farmland.
- Aquaponics uses 90% less water than traditional farming. Water and nutrients are recycled in a closed-loop fashion which conserves water.
- No harmful fertilizer run off into the water shed. In efforts to maintain nutrient rich soil, farms have to use a lot of fertilizers; those excess fertilizers eventually make it the rivers, where there are countless harmful side effects.
- "Food Miles" are greatly reduced. Our produce only travels less than five miles from farm to consumer. Only serving the local community reduces harmful gas emissions.
- Even with grow lights, we use less energy than conventional commercial farming! All energy used in aquaponics is electrical, so alternate energy systems such as solar, wind, and hydroelectric can be used to power our farm.
- Our system grows six times more per square foot than traditional farming.
- Also, by growing in abandoned warehouses, we are using structures that already exist, saving money, energy and other valuable resources.

Small farms in their size and gross sales revenue, and they utilized more direct sales outlets to sell their products than a typical small farm. We found that gross sales revenue and profitability were higher for operations that diversify their revenue stream by selling non-food products, services, or educational trainings. These are new businesses that expect to be profitable in the short term,