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AQUAPONICS- SOIL LESS INDOOR FARMING SYSTEM

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Aquaponics is a low-input, low-waste food production method that employs circular economy principles and a biocompatible natural system. It is a diligent technique that perfectly integrates with intensive agriculture's long-term expansion. Aquaponics is sustainable farming system involving two production system i.e. recirculating aquaculture system (RAS) and hydroponic cultivation. Fish and crustaceans are farmed in a tank in recirculating aquaculture, whereas vegetables are grown in a media other than soil in hydroponic cultivation. The water of recirculatory tank containing fish waste (rich in nitrogenous waste) used as fertilizer in hydroponic unit. In the context of climate change, Aquaponics is emerging as a crucial technology with the potential to transform agriculture and improve food security, particularly in dry places.

Basic Components of Aquaponics System

Fish-Fish are a key aspect of an aquaponics system since they supply natural fertilizer for the plants; therefore selecting the correct fish to raise in your aquaponics system is critical.

Plants-We may grow a number of plants in an aquaponics system, and deciding which ones to cultivate can be a fun part. Plants, on the other hand, have distinct needs and may flourish in a variety of conditions. The selection of the right aquaponics plants is crucial to the system's success.

Bacteria-In an aquaponic system, fish and plants need a healthy bacterial population to survive. Bacteria are required for an aquaponic system to function properly. Nitrification is the process by which bacteria convert fish waste into nutrients for plants.

Nitrification is the conversion of organic compounds to nitrites, which are then converted to nitrates. This is accomplished by Nitrosomonas converting ammonia to nitrite. Nitrobacter then transforms nitrites to nitrates. They can be absorbed by plants once they have been transformed to nitrates.

Fish Tanks-The fish tank is place where the fish kept in aquaponic system , so the selection of right fish tank to will help the fish to thrive well and to make an aquaponics system run smoothly.

Grow Bed-Plants can be cultivated in a grow bed, nft pipes, or floating rafts, depending on our aquaponics design. Because this is where our plants develop, the grow bed is the cornerstone of our aquaponics system. As a result, the grow bed we choose is important to the success of our aquaponics system.

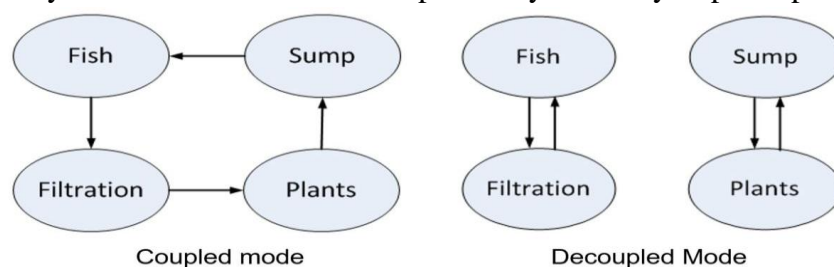
Water Pump- The selection of suitable water pump will ensure the continuous flow of water throughout the whole aquaponics system, to maintain the continuous movement of nutrients from fish tank to plants or vice versa.

Plumbing- The plumbing or pipe works are an integral part of an aquaponics system. Plumbing provides a platform for the plants and fish to coexist symbiotically by maintaining the continuous movement of nutrients in the system.

How an Aquaponics System Works?

Plants are cultivated in the grow bed, while fish are kept in the fish tank in Aquaponics. The ammonia-containing water from the fish tank is fed to the grow bed, where billions of naturally occurring helpful bacteria break it down into nitrites and ultimately nitrates. Nitrates and other nutrients are absorbed by plants to aid their growth. The roots of the plant clean and filter the water before it returns to the fish tank to survive. The oxygenated, fresh water recirculates back to the fish tank, where the cycle begins again.

The fish system can be controlled independently of the hydroponic plant system in an aquaponics farm that is "de-coupled." Water from tanks flows through a series of filtering



tanks before entering the hydroponic system in normal operation. This filtered, clean water is returned to the fish system by a single pump. In de-coupled mode, water from the fish tanks passes through the filtering system normally, but it does not pass into the hydroponic troughs; instead, it returns to the fish tanks via a separate line.

Suitable Fish Species for Aquaponics

Fishes are very important part of any aquaponics system. The fish species suitable for aquaponics system should have similar needs same as plants and also they should also tolerate high stocking density. Fish Species like Tilapia, Catfish, Koi, Pacu, Carps, Pangas and some ornamental fishes like angel fish, guppies, tetras, sword fish etc. are suitable for aquaponics farming.

Ideal Vegetable varieties for Aquaponics

Vegetable varieties which have higher nutritional demands and capable to survive in heavily stocked area suitable for Aquaponic farming. Vegetable varieties like Carrots, Beets, Radish, Cauliflower, Cabbage, Broccoli, and leafy Lettuce etc. are mostly used in Aquaponics Farming.

Table 1: General water quality tolerances for fishes, hydroponic plants and nitrifying bacteria in Aquaponic System.

Organism type	Temp (°C)	pH	Ammonia (mg/litre)	Nitrite (mg/litre)	Nitrate (mg/litre)	DO (mg/litre)
Warm water Fishes	22–32	6–8.5	< 3	< 1	< 400	4–6
Cold water fish	10–18	6–8.5	< 1	< 0.1	< 400	6–8
Plants	16–30	5.5–7.5	< 30	< 1	-	> 3
Bacteria	14–34	6–8.5	< 3	< 1	-	4–8

Merits of Aquaponics as a Food Production System

- Sustainable food production system.
- Two agricultural products (fish and vegetables) are produced from one nitrogen source (fish food).
- Extremely water efficient.
- Soil less farming.

- No requirement of Chemical or fertilizers.
- Production of good quality crops with high yield..
- Higher control on production leading to lower losses.
- Can be used on non-arable land such as deserts, degraded soil or salty, sandy islands.
- Creates little waste.

Demerits of Aquaponics System

- When compared to soil vegetable cultivation or hydroponics, the initial start-up expenditures are higher in Aquaponics.
- Each farmer must have knowledge of fish, bacteria, and plant production in order to be successful.
- Sometimes the needs of fish and plants do not always coincide.
- It requires daily management practice.
- Electricity, fish seed, and plant seeds must all be available on a consistent basis.

Conclusion

Aquaponics is a combination of aquaculture and hydroponics in which the aquaculture system's nutrient-rich waste water is redirected into the hydroponic system. Environmental regulations in the modern era are limiting the amount of water that can be consumed or disposed. Deserts and arid areas, sandy islands and urban gardens are the locations most appropriate for Aquaponics because it uses absolute minimum of water. As a result in the aquaponics system wastewater of aquaculture unit is purified and recirculated back into the hydroponics system. The wastewater comes from aquaculture unit is rich in nitrogen and other organic materials which is act as good organic fertilizer for the plants of hydroponic unit.

Now days Aquaponics arises an opportunity in the field of indoor farming by providing two sources of income i.e. fish and Vegetable for the marginal farmers to make more money by utilizing small area of land.

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