User Manual
IRADA's Aquaponics Systems
(Media-based, DWC and NFT)

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Table of Contents

I. Introduction to Aquaponics

Definition

Aquaponics is a sustainable and efficient method of food production that combines aquaculture (raising fish) and hydroponics (growing plants in water) in a closed-loop system. In this symbiotic environment, the waste produced by the fish provides nutrients for the plants, which in turn cleans the water for the fish. This creates a self-sustaining system that can produce both fresh fish and vegetables with minimal inputs of water and energy, making it a great option for urban or indoor farming.

Benefits

Sustainability: Aquaponics is a sustainable method of food production that uses less water and energy compared to traditional farming methods. It is a closed-loop system that recycles water and nutrients, reducing the need for fertilizers and pesticides.

Efficiency: Aquaponics is an efficient method of food production, as it allows for the simultaneous growth of fish and plants in the same system. The plants use the waste produced by the fish as a source of nutrients, while the plants help to clean the water for the fish.

Year-round production: Aquaponics allows for year-round production of fresh vegetables and fish, regardless of the weather outside. This makes it an ideal method for urban or indoor farming.

Space-saving: Aquaponics can be set up in small spaces, making it ideal for urban areas where space is limited. Vertical growing techniques can also be used to increase the yield per square foot of growing space.

Healthy food production: Aquaponics produces fresh, healthy, and organic vegetables and fish. As the system is free from pesticides, herbicides, and other harmful chemicals, the food produced is safe for consumption.

Educational opportunities: Aquaponics can be a great educational tool for teaching children and adults about sustainable food production, biology, and the environment.

Overall, Aquaponics is a sustainable, efficient, and innovative method of food production that offers a range of benefits for both growers and consumers

II. System Components

- **Fish tank**

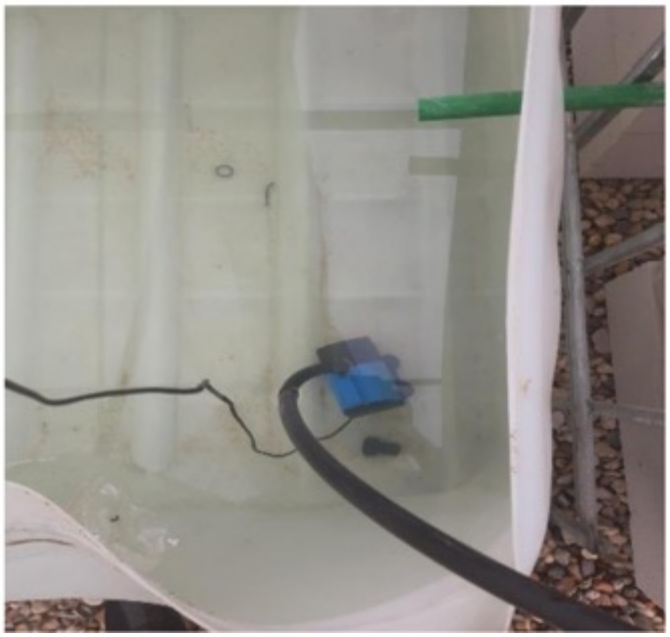
The fish tank is the heart of the aquaponic system, where the fish are raised. The size of the tank depends on the number and type of fish you plan to raise. In this case we will be using 1000 liter IBC tanks.

- **Grow bed**

  The grow bed is where the plants are grown. It can be filled with a growing medium such as gravel, perlite, expanded clay balls or just water depending on type of the system design. The plants are typically grown in net pots, which are placed on the surface of the grow bed or planted directly in gravel.

- **Water pump**

  The water pump is used to circulate water from the fish tank to the grow bed and back. The pump helps to distribute the nutrients from the fish waste to the plants.



- **Filtration system**

  The filtration system helps to remove solid waste and excess nutrients from the water before it is returned to the fish tank. This helps to maintain good water quality and keep the fish healthy. Also, the filtration system is where the nitrification process happens. Nitrification is a biological

process that converts ammonia and nitrite in the nitrogen cycle into nitrate. This process is important in the cycling of nitrogen in natural and engineered ecosystems such as soils, water bodies, and wastewater treatment systems.

- **Sump**: This is the container placed under the media based grow bed to collect the water and pump it back to the fish tank.

- **Aeration system**: An aeration system is used to oxygenate the water in the fish tank. This is important for the health and wellbeing of the fish and the roots of the plants. Air compressor is used to deliver air to each section. In this case we need air tubes to our DWC beds, bio filter and fish tanks. Air stones are then connected to the end of each outlet to create as much dissolved oxygen as possible.

- **Plumbing**: Plumbing is used to connect the various components of the aquaponic system, such as the fish tank, grow bed, water pump, and filtration system.

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plumbing done to get the water from bio
filter to the nft pipes using the pump


plumbing done to get the water from fish
tank to media beds using gravity

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plumbing done to get the water from fish
tank to media beds using gravity

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plumbing done to get solid settled at the
bottom of the swirl filter out

These components work together to create a closed-loop system that recycles water and nutrients, allowing for the sustainable production of both fish and plants

III. Types of filters

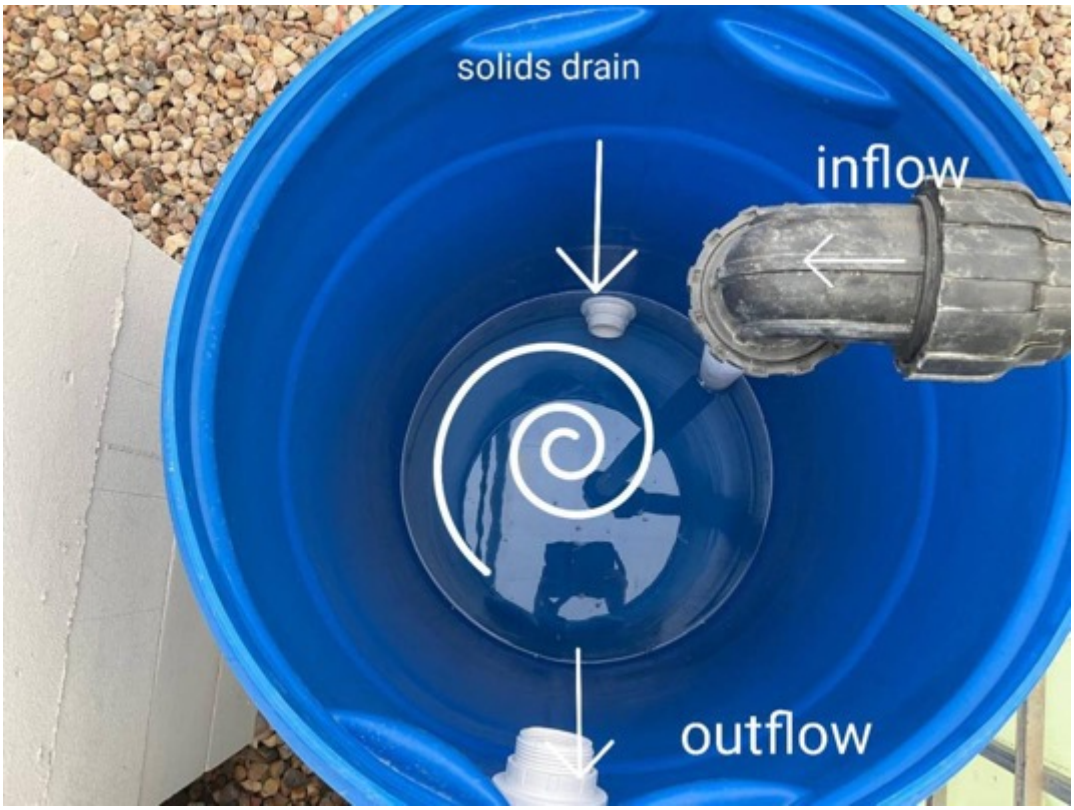
- **Swirl filter**

A swirl filter is a type of mechanical filter used in aquaponics and other types of water filtration systems. It works by using centrifugal force to separate solid waste from the water, which can then be removed from the system.

The way a swirl filter works is by directing the water into a cylindrical chamber, where it is forced to spin in a circular motion. As the water spins, heavier solids such as fish waste, uneaten food, and plant debris are flung out to the sides of the chamber and collect at the bottom, while the cleaner water flows out through an outlet at the top or center of the chamber.

Swirl filters are effective at removing solid waste from the water, which can help to reduce the workload of other filters in the system and improve water quality. They are relatively simple to build and maintain, and can be constructed from materials like PVC pipes or food-grade barrels.

However, it's important to note that swirl filters only remove solid waste and do not address other water quality parameters such as pH, dissolved oxygen, or ammonia levels. Therefore, they should be used in conjunction with other types of filtration, such as biological and chemical filters, to maintain a healthy and balanced aquaponics system.

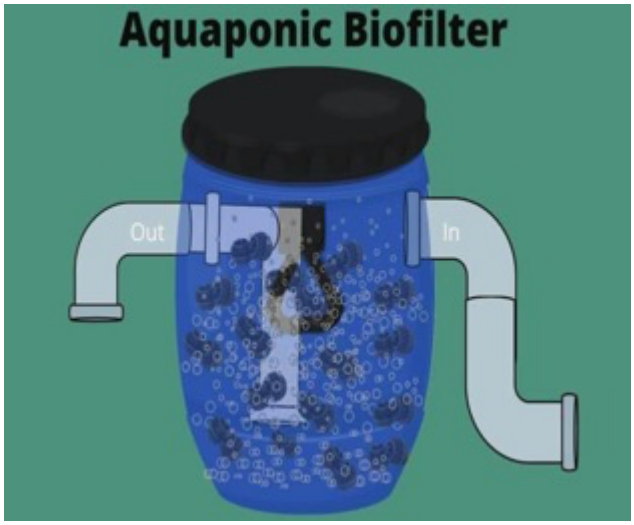


- **Bio-filter**

A biofilter is a type of filter used in aquaponics and other aquatic systems to remove harmful compounds such as ammonia and nitrite from the water. These compounds are produced by fish waste and uneaten food, and can be toxic to fish and plants if they build up in the water.

A biofilter works by providing a home for beneficial bacteria, known as nitrifying bacteria, which convert harmful compounds into less harmful ones. These bacteria attach themselves to surfaces such as gravel, plastic media, or sponge material inside the filter, where they break down ammonia into nitrite, and then nitrite into nitrate.

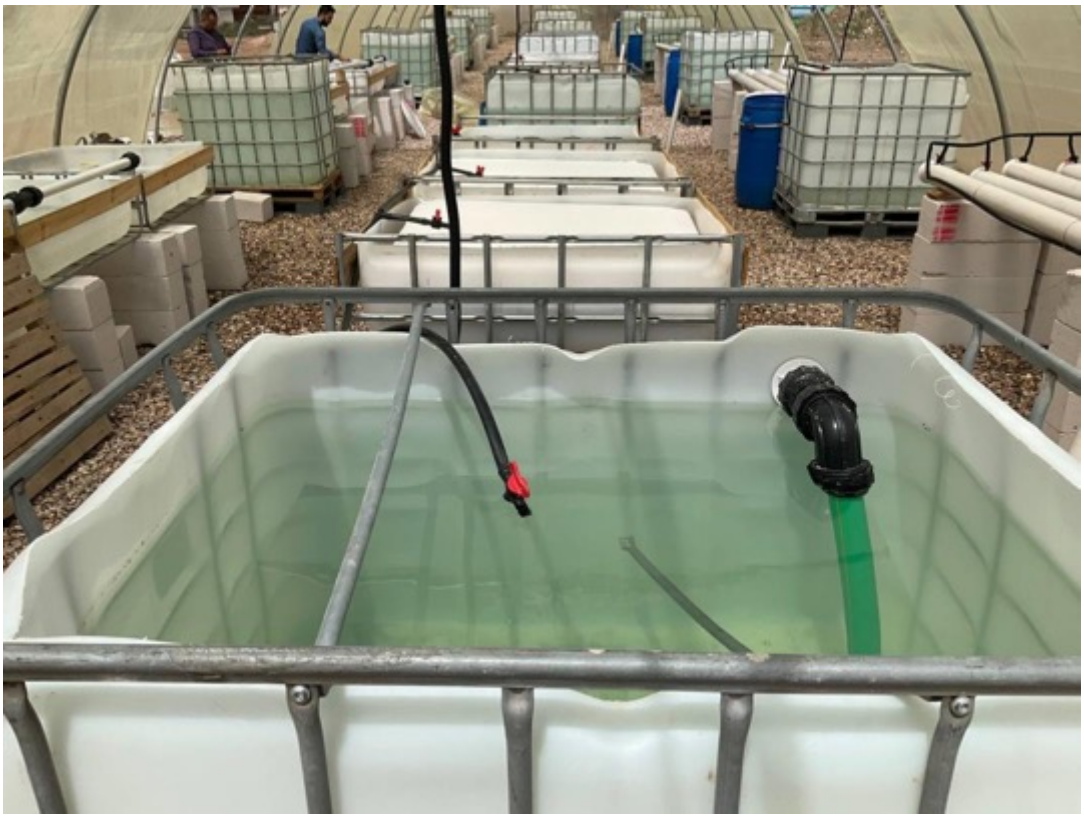

inflow from swirl filter
this barrel will be filled with bio media or any material with enough surface area for bacteria to grow and then aerated with air stones to start the nitrogen cycle
bio-filter

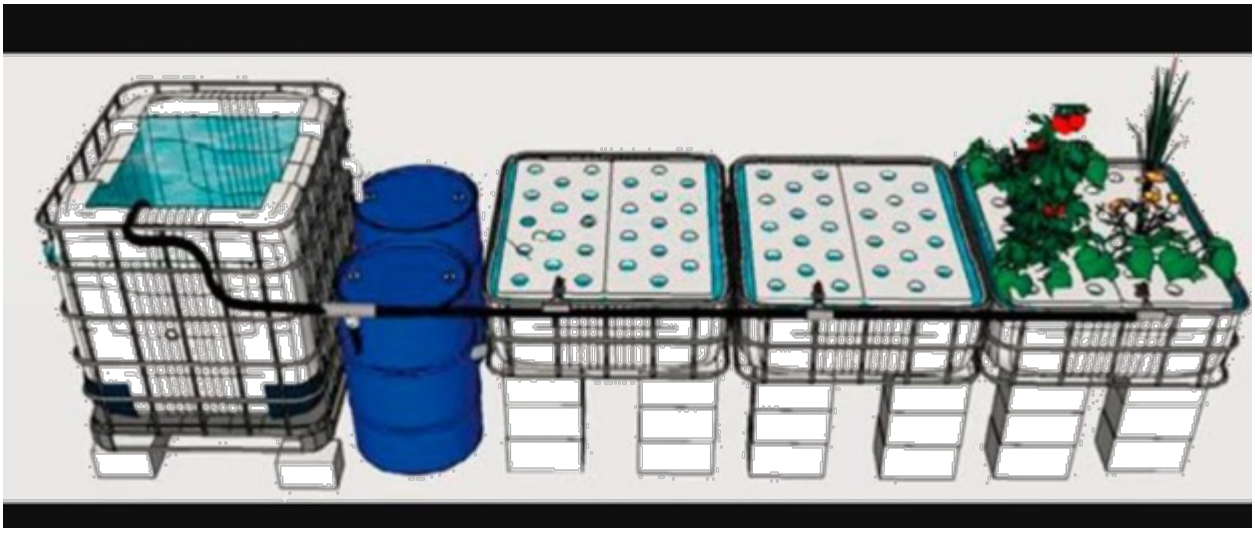

Aquaponic Biofilter
Out
In

IV. Types of systems

There are several different types of aquaponic systems, each with its own advantages and disadvantages. Some of the most common types of aquaponic systems include:

- **Deep Water Culture (DWC)** - This system involves suspending plants in a nutrient-rich solution of water and fish waste. The plants roots are submerged in the water, and the fish waste provides the necessary nutrients for plant growth. These foams are placed on top of beds filled with water and then netcups holding each plant will be placed onto them.





- **Media-based aquaponics** - In this system, plants are grown in a media-filled bed or container, with water circulated from a fish tank through the bed. The media, such as gravel or clay pebbles, provides a surface area for beneficial bacteria to colonize, which helps to break down fish waste and maintain water quality.

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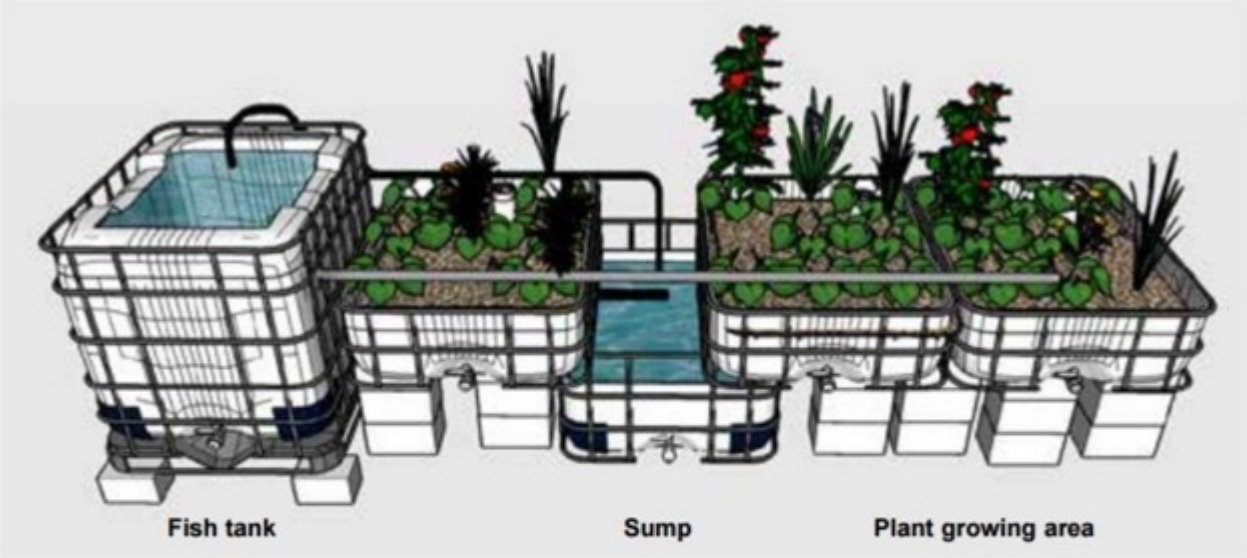


- **Nutrient Film Technique (NFT)** - In this system, plants are grown in a long channel with a thin film of nutrient-rich water flowing over their roots. The water is recirculated from a fish tank and provides nutrients for the plants.

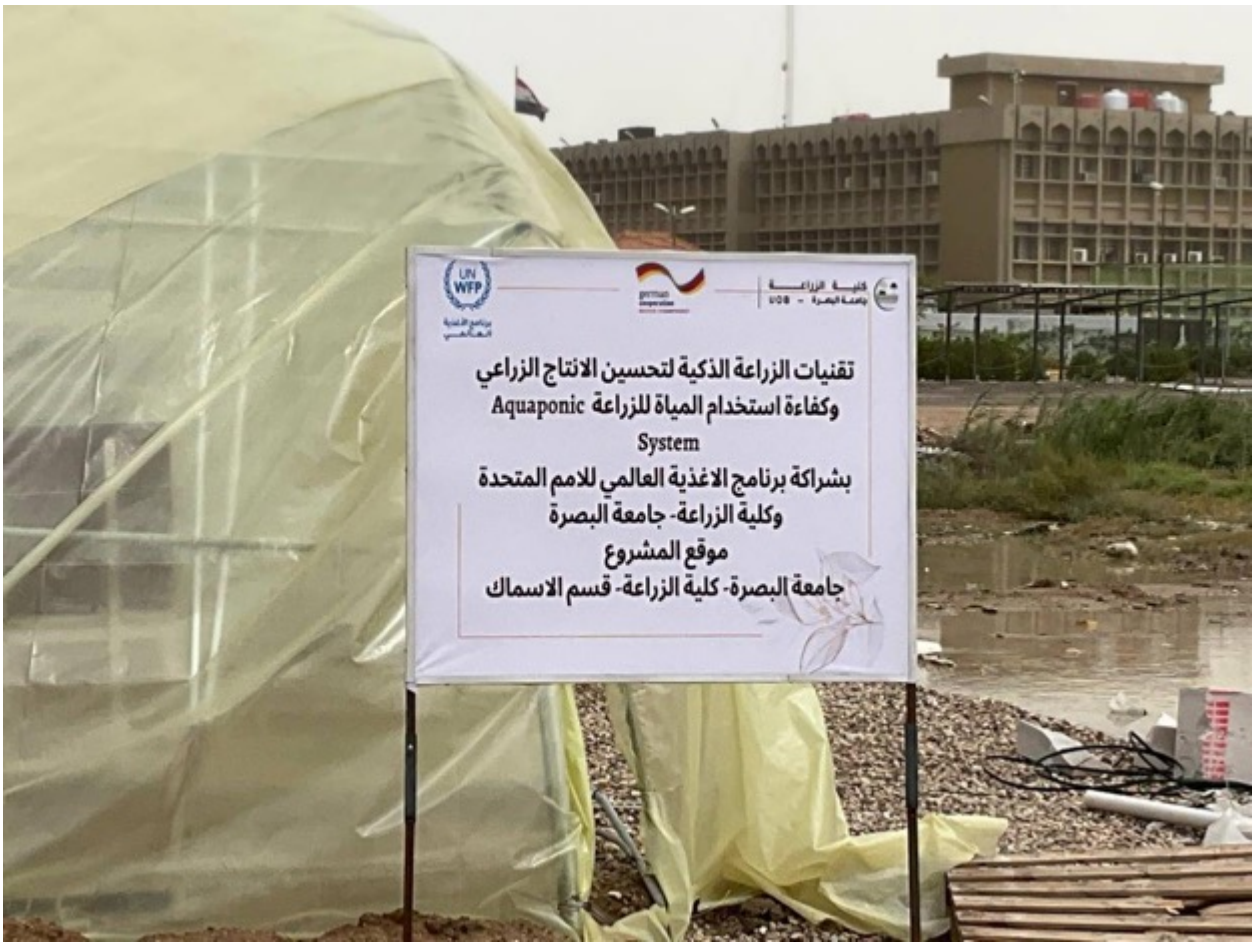
- **Vertical aquaponics** - This system uses vertical grow towers or stacked layers to maximize growing space while minimizing the overall footprint of the system. Water is recirculated through the towers, providing nutrients for the plants and helping to filter the water.

The choice of aquaponic system will depend on factors such as the size and space available, the types of plants and fish being grown, and the level of control required over the environment. Each system has its

own advantages and disadvantages, and it's important to carefully consider the specific needs of your system before choosing a system type.

V. Setting up the System

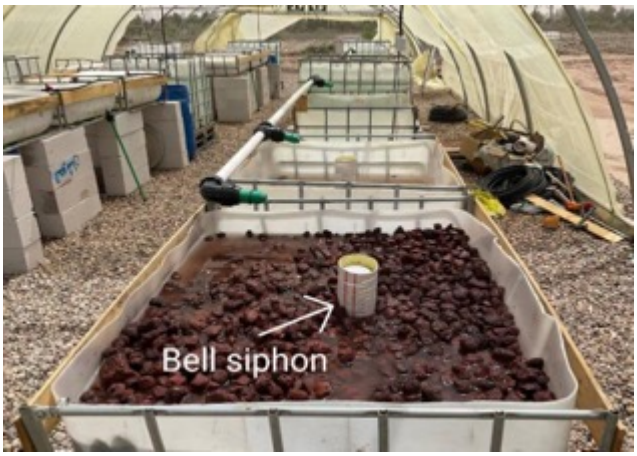
- **Choose a location** - The location of the aquaponic system should be level and have access to electricity, water, and drainage. The area should also be sheltered from extreme weather conditions, such as high winds or direct sunlight.

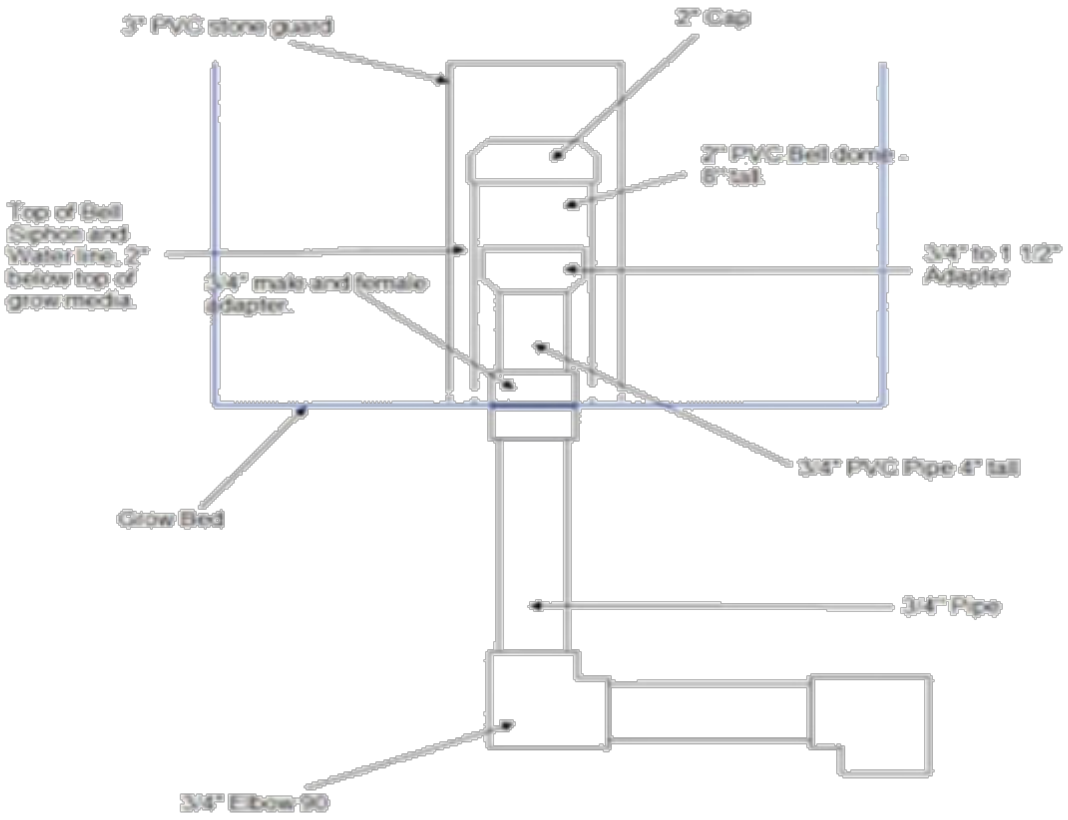


- **Choose the system type** - choose the right system from the previous section based on your specific needs and available space. In this case we have three types of system design (media based, DWC and NFT)
- **Set up the fish tank** - The fish tank should be large enough to support the number and size of fish you plan to keep. Fill the tank with water and add a filtration system, such as a biological filter or swirl filter, to remove solid waste.

- **Set up the grow bed** - The grow bed should be filled with a growing medium, such as gravel or clay pebbles. The grow bed should also be connected to the fish tank using pipes or tubing.

- Bell siphon – if you are using the media based designs then you need to build a bell siphon in order to drain the beds and provide air to the roots and nitrification bacteria.





- Troubleshoot the bell siphon - Check for proper installation: Make sure your bell siphon is properly installed and set up according to the previous instructions. If there are any obvious installation issues, correct them before proceeding with further troubleshooting.

- Check for debris: Inspect the bell siphon and surrounding area for debris or clogs that may be preventing it from working properly. Clear any debris you find.

- Check the water level: Ensure that the water level in your grow bed is high enough to trigger the bell siphon. The water level should be above the bottom of the standpipe. If the water level is too low, adjust it accordingly.

- Check the standpipe: Verify that the standpipe is not too short or too tall. If the standpipe is too short, it may not create enough vacuum to trigger the siphon. If the standpipe is too tall, it may prevent the siphon from breaking. Adjust the height of the standpipe accordingly.

- Check the bell: Make sure the bell is not obstructed or blocked. If it is, it may prevent water from flowing properly, causing the siphon to fail. Clear any obstructions you find.

Over-flow stand pipe – if you are using the floating raft (DWC) system design you need a stand pipe to get the water back to you bio-filter where it is pumped back to the fish tank.

- **Add plants and fish** - Add plants to the grow bed and fish to the fish tank. The plants should be chosen based on their nutrient requirements and ability to thrive in an aquaponic system. The fish should be chosen based on their ability to tolerate the water conditions and temperature.
- **Monitor and maintain the system** - Regularly monitor the water quality, pH, and temperature of the system. Adjust the feeding of the fish and the flow rate of the water to maintain a balance between the fish and plants. Regularly clean the filters and remove any excess debris or waste.
    - **PH control**

      In aquaponics, pH control is important for maintaining a healthy environment for your fish and plants. Here are some steps to adjust pH in aquaponics:

      Use a pH test kit to determine the current pH level of your system. The ideal range for most aquaponics systems is between 6.8 and 7.2, but this can vary depending on the types of plants and fish you are growing.

      Add acid or base: If your pH level is too high (above 7.2), you can add an acid such as vinegar, citric acid or hydrochloric acid to lower it. If the pH is too low (below 6.8), add a base such as potassium hydroxide or sodium bicarbonate to raise it. Be sure to add small amounts at a time and re-test the pH after each addition.

Monitor the pH: Once you've made an adjustment, monitor the pH level regularly to ensure it stays within the ideal range. Changes in pH can happen quickly, so it's important to stay on top of it.

Use natural methods: To maintain a stable pH level in your aquaponics system, you can use natural methods such as adding plants that naturally lower the pH (e.g. blueberries, strawberries, or coffee grounds), or using a buffering agent like crushed oyster shells or dolomite.

Avoid sudden changes: Avoid making sudden changes to the pH level in your system, as this can shock the fish and plants. Make adjustments gradually and monitor the system closely to ensure the pH rema ins stable.

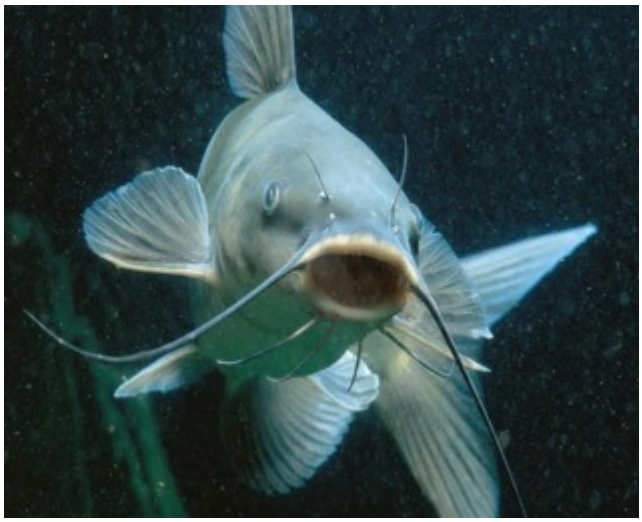
These are general steps to setting up an aquaponic system, but the specific details will vary depending on the type and size of the system you choose. It's important to consult with our experts (info@irada-iq.com) to ensure a successful set up and operation.

VI. Choosing the Right Fish

- **Tilapia** - Tilapia is one of the most commonly used fish in aquaponics because it is hardy, fast-growing, and tolerant of a wide range of water conditions.

- **Trout** - Trout is a cold-water fish that is often used in aquaponics systems located in cooler climates.

- **Catfish** - Catfish is another hardy fish that is well-suited to aquaponics. They can grow quite large and are tolerant of a wide range of water conaquaponi



- **Barramundi** - Barramundi is a warm-water fish that is well-suited to aquaponics systems located in tropical or subtropical climates. They are fast-growing and have a mild flavor.

- **Koi** - Koi are a popular ornamental fish that can be grown in aquaponics systems. They are hardy and can tolerate a wide range of water conditions.

- **Goldfish** - Goldfish are another ornamental fish that can be grown in aquaponics systems. They are hardy and can add a pop of color to your tank.

- **Crayfish** - Crayfish can be grown in aquaponics systems as a source of protein. They are hardy and can tolerate a wide range of water conditions.

VII. Advanced topics.

The nitrification process involves two types of bacteria: ammonia-oxidizing bacteria (AOB) and nitrite-oxidizing bacteria (NOB). AOB oxidize ammonia to nitrite (NO_2^-), and NOB oxidize nitrite to nitrate (NO_3^-).

The nitrification process occurs in two stages:

Ammonia oxidation: In this stage, AOB use oxygen to oxidize ammonia (NH_3) to nitrite (NO_2^-), releasing hydrogen ions (H^+) and consuming oxygen (O_2).

Nitrite oxidation: In this stage, NOB use oxygen to oxidize nitrite (NO_2^-) to nitrate (NO_3^-), releasing more hydrogen ions and consuming more oxygen.

The end product of nitrification is nitrate (NO3-), which is less toxic to aquatic organisms than ammonia or nitrite. Nitrate can be used by plants as a source of nitrogen, which is an essential nutrient for plant growth.

The nitrification process is important in many applications, including wastewater treatment, aquaculture, and aquaponics. It helps to remove harmful ammonia and nitrite from water, creating a safer environment for aquatic organisms. It also provides a source of nutrients for plants, helping to support their growth.

VIII. Final Thoughts

Aquaponics can be a good idea in Iraq, as it is a sustainable and efficient way to produce food using limited resources such as water and land. Iraq has a hot and dry climate, with limited arable land and water resources, which can make traditional farming challenging. However, aquaponics systems can be designed to be very efficient in their water use, making them suitable for areas with water scarcity.

Additionally, aquaponics can be set up to produce a variety of crops and fish, which can provide a diverse and healthy source of food for local communities. In Iraq, where the economy has been challenged by years of conflict, aquaponics can provide an alternative source of income for farmers and entrepreneurs.

However, there are some challenges that need to be considered when implementing aquaponics in Iraq, such as access to materials, availability of expertise, and the cost of setting up and maintaining the system. It is important to conduct a thorough feasibility study and seek out expert advice before embarking on an aquaponics project in Iraq.