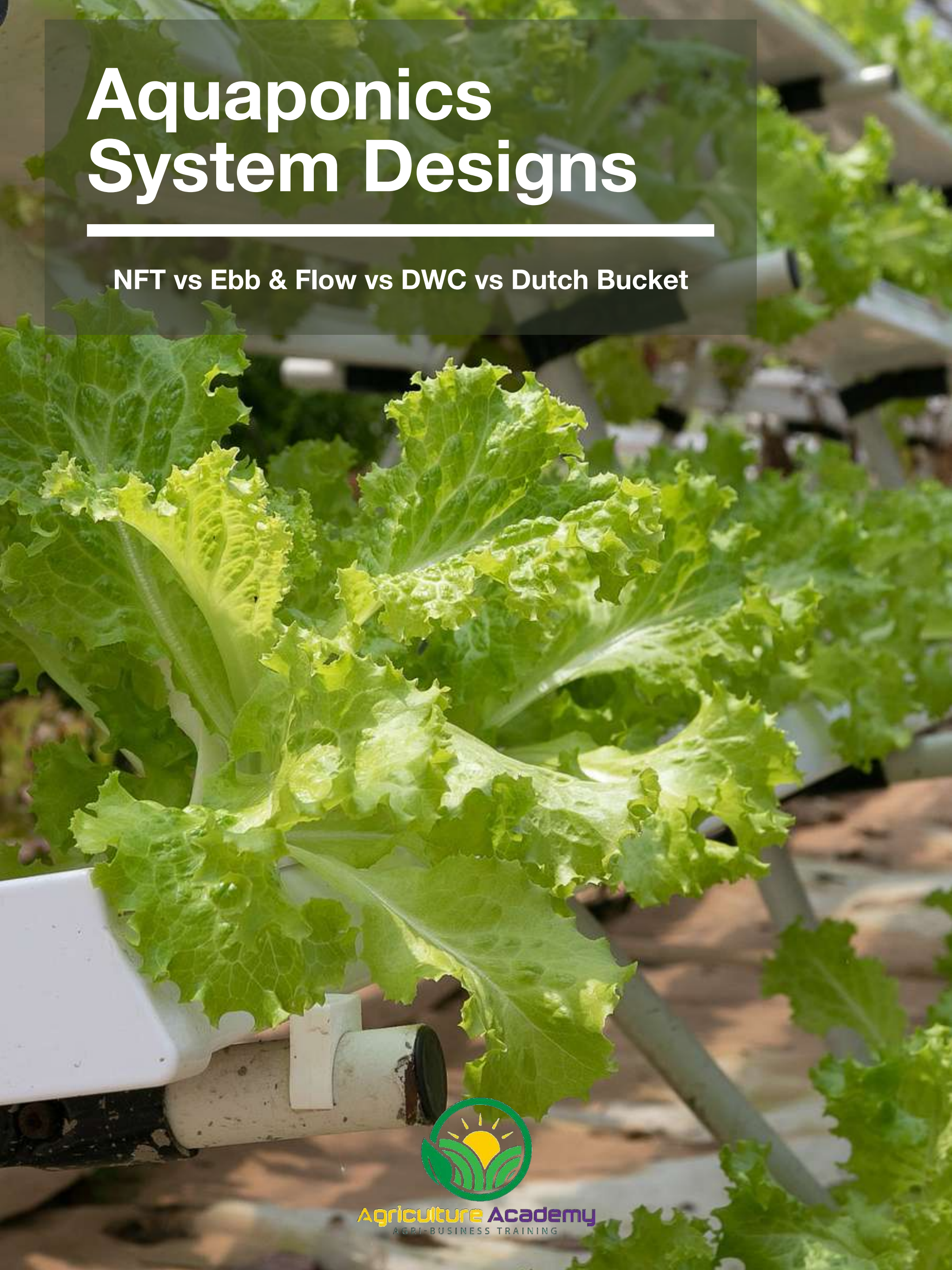
Aquaponics System Designs

NFT vs Ebb & Flow vs DWC vs Dutch Bucket



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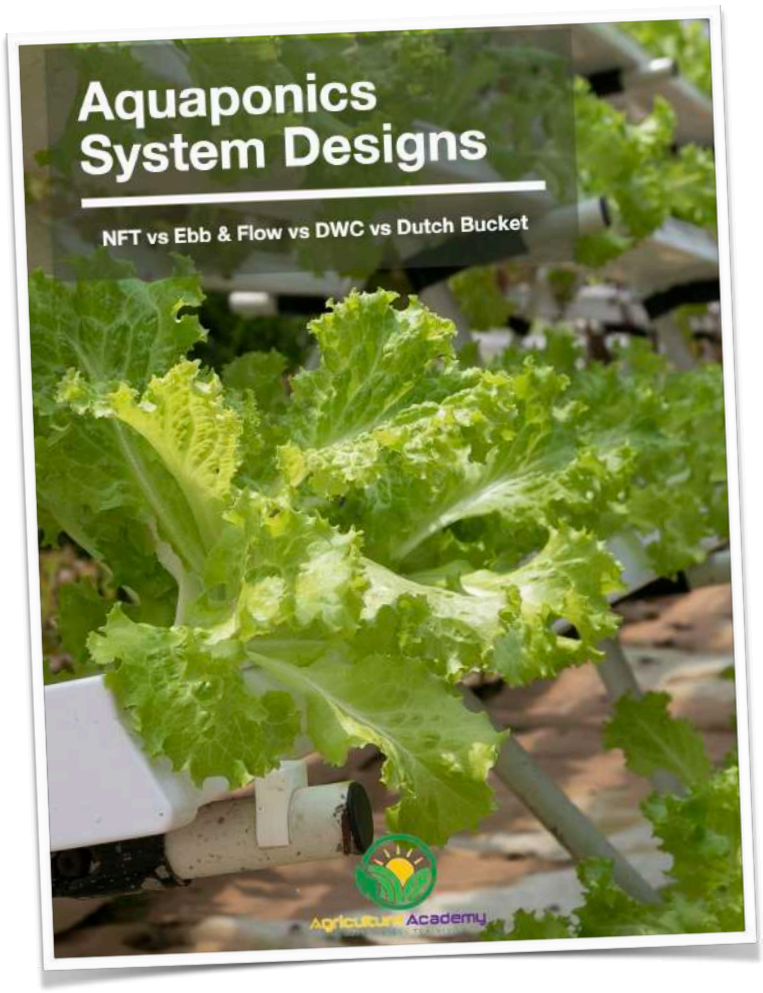
Aquaponics System Designs

Thank you for downloading this guide!

Do you want to start your own aquaponics system? Are you in need of some advice on which system is best for you? Well, we have got you covered! In this eBook we are going to take a look at the different aquaponics systems you can use to grow your own vegetables, sustainably and efficiently. We are going to discuss the details of the **Nutrient Film Technique**, **Ebb and Flow** or Media Based designs, **Deep Water** systems, and **Dutch Bucket** set ups. For the sake of clarity before we begin, these systems are also applicable for hydroponic production, while you will have the fish culture separate from these systems if you apply them to aquaponics.

Let's get started!



Nutrient film technique (NFT)

In this traditional hydroponic system, the name does most of the explaining. A small stream, or film, of nutrient-rich water periodically flows over the roots of plants. The nutrient-rich water contains all the necessary macro and microelements required by the plants for optimum growth. The water flows from the nutrient tank, through the plant system, and back into the nutrient tank. This system can be modified slightly to fit the needs of an aquaponics set up. The nutrient tank will usually be replaced by the fish tanks from which the nutrient-rich water will be siphoned out of.

To set up your NFT as a part of an aquaponics system, you will need:

· **Long pipes or reservoirs** to hold the plants. These pipes must be food-grade. The plants are usually kept in small pots which may or may not be filled with an inorganic substrate.

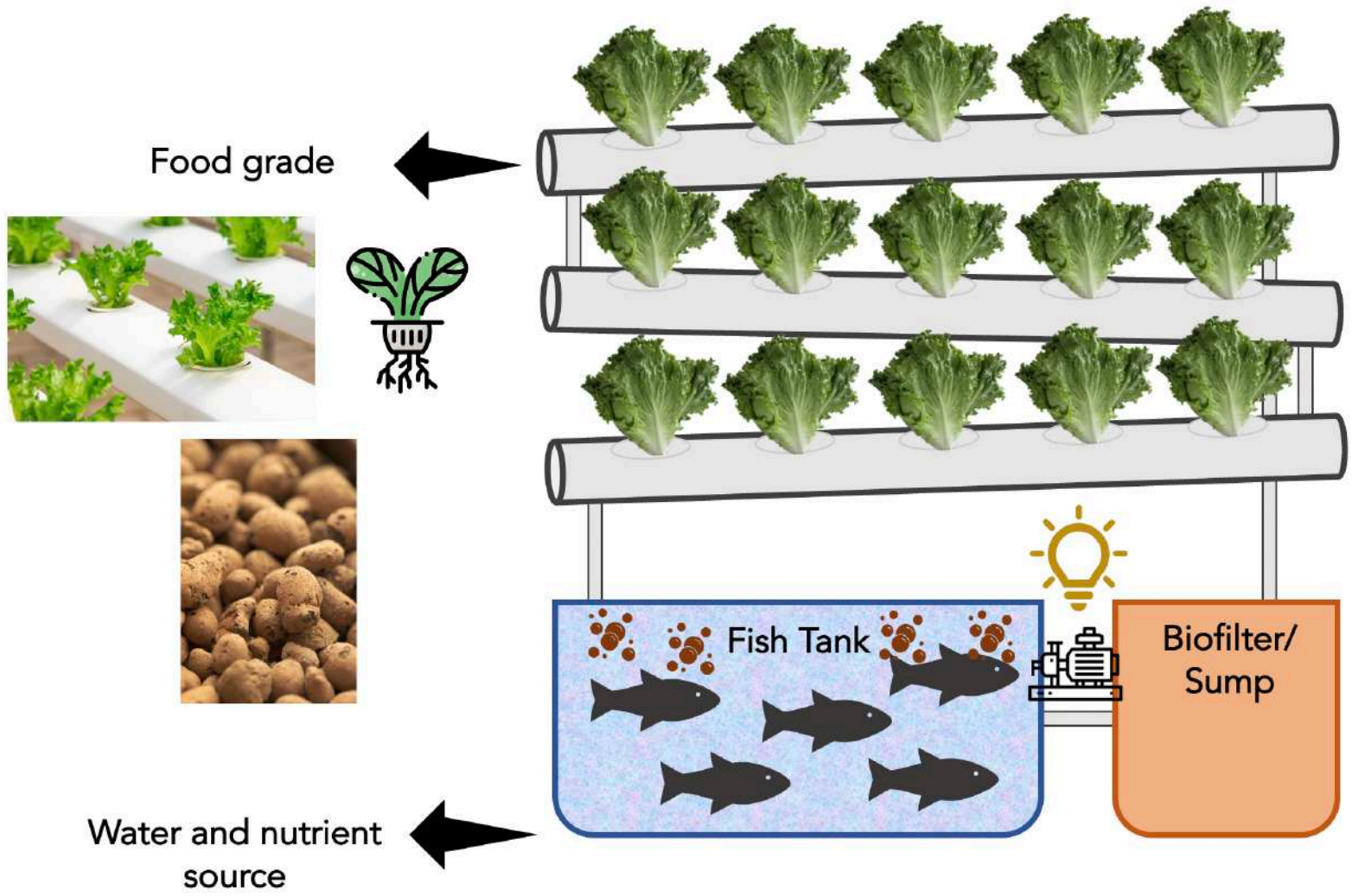
· A **fish tank**, or container large enough to hold your **fish**. This will act as both a water and nutrient source for your plants. Remember you will also need fish food to sustain the fish.

· A **pump** to siphon the water from the tanks through the plant system.

· An **electricity source**, or batteries for the pump.

· **Biofilters** to convert toxic fish waste to plant usable nutrients. These can be placed in an extra sump tank.

Put simply, beneficial microbes convert toxic fish waste into plant-usable nutrients. These microbes thrive in dark environments. Biofilters are made of inorganic materials, like bags of gravel, on which microbes thrive. The plant-friendly fish water is pumped from the tanks, through the biofilters, then into the pipe system. The plants are kept in place in holes along the pipe. The pipe is sloped on a gentle gradient that allows the water to flow through the system, and then return to the fish tank.



Nutrient Film Technique (NFT)

Take these factors in to consideration before you select the NFT system:

1. **Water testing is a must**! This factor applies to all hydroponic systems, and aquaponics systems especially. Most of the nutrients in aquaponics are supplied by the fish waste. This creates two problems: 1. This waste is toxic to the plants and must be converted to plant-friendly forms before the water can be cycled through the system. You will therefore need to cycle your NFT system for a few days or weeks and continually test the nutrient levels. Once they are in the plant-safe region, then only add your crops to the system. The second problem is that the nutrient levels will fluctuate depending on fish species, temperature, crop type and age, water leaks and other factors. You will therefore need to test for any deficiencies or toxicities. If you need to add supplemental fertilisers to the system, make sure they are safe for the fish.

2. **A reliable electricity source is vital**. Any interruption to the water supply will lead to plant stress and even death. Because there is no soil to

retain water, the plants have no chance of surviving if they are deprived of water. This can be especially problematic if you are in a rural area or third world country. If possible, consider back up solar power, but this can be very expensive. At the very least, have batteries on hand to keep your water pumping through the system during power outages.

3. **Not all plants capable of being grown in aquaponics or hydroponics can be used in the NFT systems**. This is due to the small growing area for the root systems. Generally, your leafy vegetables and dwarf (or determinate) cultivar tomatoes will work. Chrysanthemum flowers have also been successfully cultivated in NFT systems.

4. **Use the correct slant angle**. Generally, slants between 0.3 and 2% are ideal. Remember, water will flow through gentler slopes slower, so test your pump rates and timing with the gradient of your pipe to see what suits you best. Be careful not to pump the water too slowly as this can lead to nutrient deficiencies in plants grown towards the end of the system.

5. **Your plants may be susceptible to root borne diseases**. This is due to both the recirculation of water and the fact that the plants are not isolated from one another, allowing any pathogen to spread rapidly. To help prevent this use filters to clean the water between cycles, and select disease-resistant crop varieties. You can also periodically flush a clean water supply through your system.

Source consulted: Source: https://www.sciencedirect.com/topics/agricultural-and-biological-sciences/nutrient-film-technique

Ebb and Flow/Media Based

In Ebb and Flow, also known as Media Based, systems a growing trough is filled with an inorganic hydroponic substrate. The plants are supported by the substrate and the nutrient-water is pumped into the trough. The water then slowly returns to the fish tank through a siphon valve in the trough.

To set up your Ebb and Flow (Media Based) System you will need:

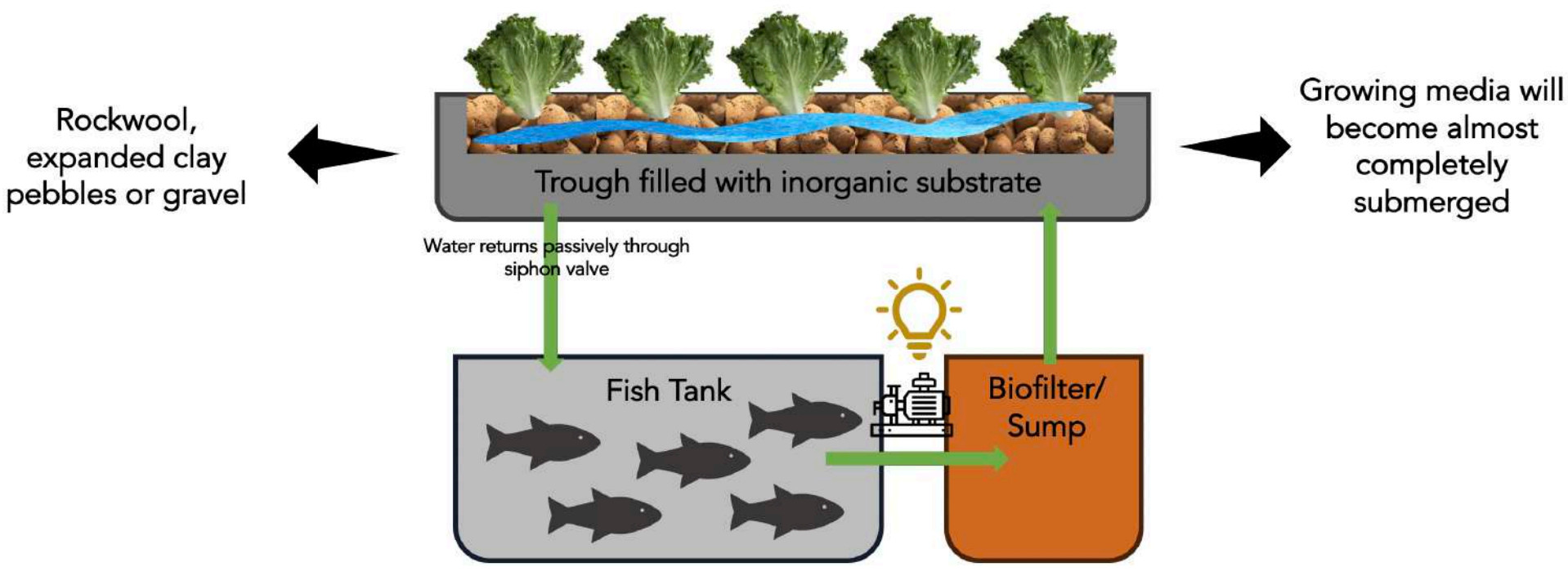
1. A large **trough** in which your plants will grow.

2. **Inorganic hydroponic substrate**, such as rockwool, expanded clay pebbles or gravel.

3. Your **fish tank** and **biofilter system**, as described for the NFT system.

4. A **pump,** ideally with a backup battery system.

The most efficient set up will consist of a fish tank at the base, over which your trough of growing media and plants is placed. A pump will deliver water into the overlying trough so that the growing media is almost completely submerged. The water will then passively return to the tanks below through the siphon valve.



Ebb and Flow (Media Based)

If you think this method is best for you, consider the following:

- Depending on how big a system you need, this can be one of the **easiest and simplest methods** for aquaponic beginners. At the very least, you can design your system with as few as two buckets, some pipes, biofilters and a pump.

- **Design your siphon valve carefully**. You can either install a manual switch to open and close when you choose, or a valve with a thin diameter that has a slower outflow rate than the inflowing water.

- You may be able to **grow bigger crops** compared to the NFT system because of the larger rootzone provided by the trough.

- The factors regarding **root borne pathogens**, **electricity supply** and **nutrient testing** discussed under the NFT system will also apply here.

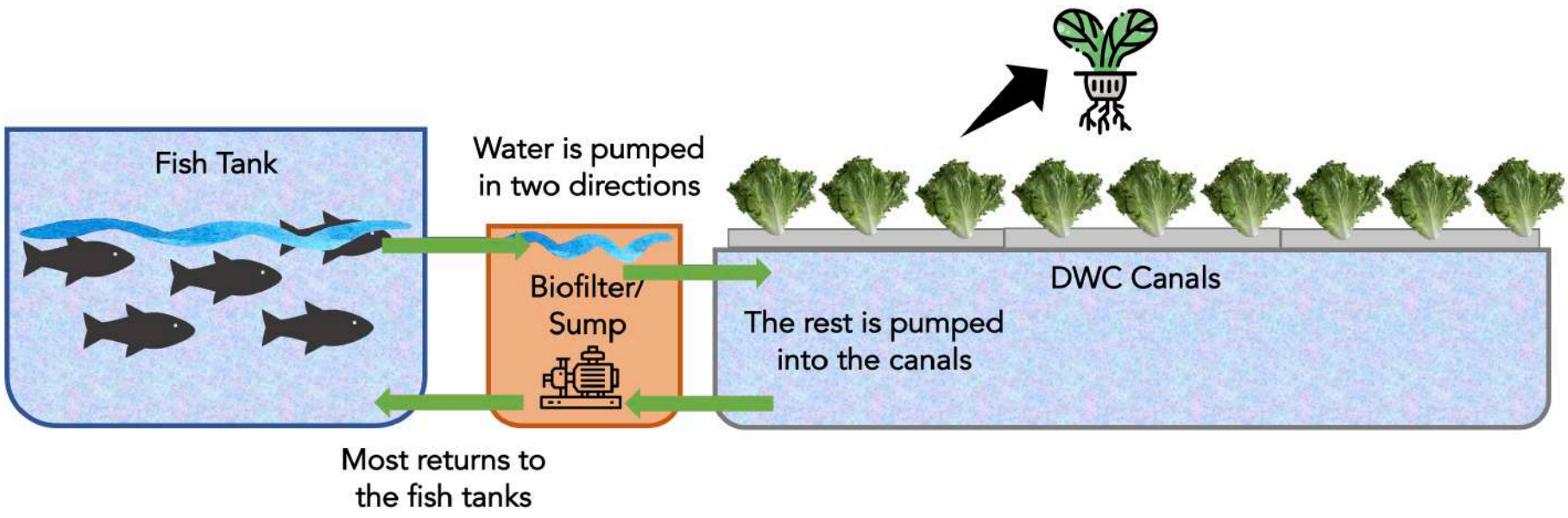
Consulted source: https://www.howtoaquaponic.com/designs/flood-and-drain-aquaponics/#:~:text=As%20soon%20as%20you%20start,or%20'ebb%20and%20flow'.&text=Flood%20and%20Drain%20aquaponics%20consist,it%20to%20the%20fish%20tank.

Deep Water Culture

Deep Water Culture systems are a great option for large scale aquaponic operations. These systems can be a bit more complicated than the NFT and Ebb and Flow systems. Here is a brief summary of how they work.

The water levels in the fish tank overflow and enter the biofilter tank. From here, the water is pumped in two directions: most of the water will return to the fish tank while the rest is pumped into the deep water culture canals. These long canals are constantly filled with the nutrient-rich, oxygenated water from the biofilter tank. Rafts, conventionally made out of polystyrene or other lightweight materials, float in the canals on top of the

water. The plants are held in place in these rafts by small holes or baskets. The water passively exits the canals and returns to the biofilter tank. And so the process is continually repeated.



Deep Water Culture (DWC)

As you can see, this method might not be suitable for small-scale hobbyists or growers on a small budget. If you are still thinking of starting your deep water culture system, here are some extra factors you should think about:

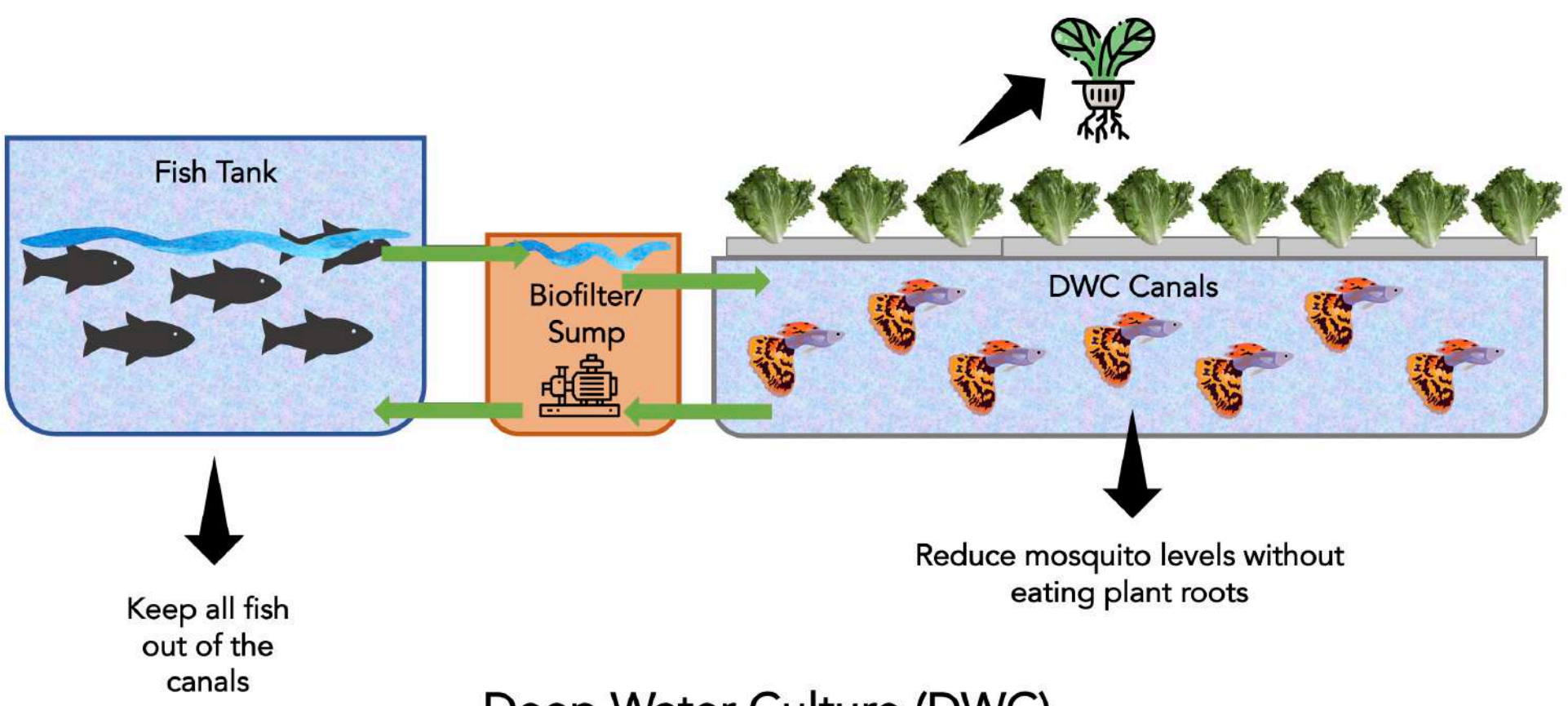
1. **You can choose your canal size**. Generally, the width will usually match that of the polystyrene rafts, or multiples thereof. The depth of the canals should be at least 30cm to allow for adequate root development.

2. **It is essential your canals be watertight**. It might be easier to control this with smaller canals, but as you increase their size a great deal of effort must be invested into construction and waterproofing.

3. **Try aim for a cycling time of 14 hours**. This will allow for adequate nutrient replenishment to the rootzone. A faster flow rate will also help supply the roots with more nutrients. You must also make sure the water is sufficiently aerated with dissolved oxygen. You can achieve this by adding air stones into the canals or installing venturi siphons to aerate the water as it enters the canals.

4. **Make sure to keep all fish out of the canals** – they can eat the roots and spell doom for your system. Some growers have had success with adding some carnivorous fish species (like guppies) to their canals. These fish will eat mosquito larvae, making for a more comfortable working environment.

Consulted source: https://teca.apps.fao.org/teca/fr/technologies/8397#:~:text=Aquaponics%20is%20the%20integration%20of,implemented%20at%20large%2Dscale%20operations.



Deep Water Culture (DWC)

Dutch Bucket Systems

In this system, a series of buckets are connected to your fish tank. The water is pumped from the fish tank through the biofilters, then through a series of thin plastic spaghetti pipes into the buckets. The buckets are filled with inorganic substrate which support the plants. Growers suggest pumping water continuously, providing a gentle, uninterrupted supply of water to the roots. Most commonly, one bucket will support a single plant.

If you want to build your own Dutch Bucket system you will need:

· **A series of buckets**. These must be filled with your inorganic substrate of choice.

· **Spaghetti pipes** to supply water to the buckets.

· **Your fish tank and biofilter system**, as described for the NFT and Ebb and Flow systems.

· **A pump**, again preferably with a backup battery system.

With this in mind, here are some points to consider:

1. There are **far more types of plants** to grow in a Dutch Bucket system compared to the others discussed in this video. Because a single plant is grown per bucket, you can even look at growing larger fruit trees aquaponically.

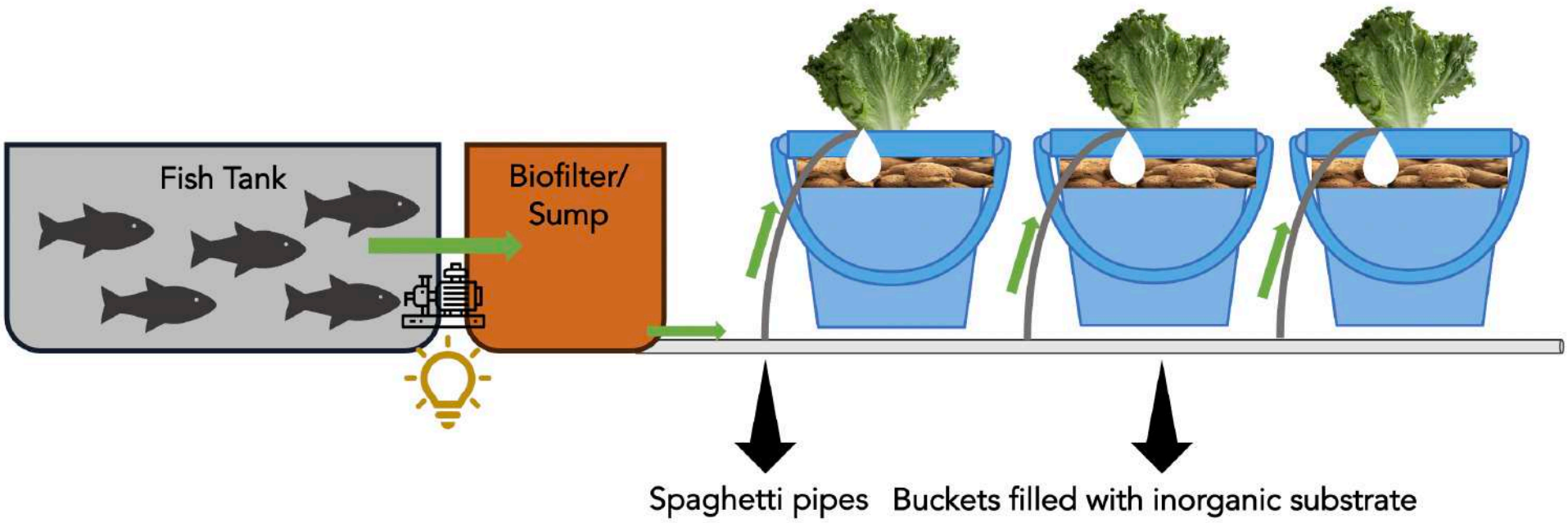
2. **Far less water is required**, especially compared to the deep water culture system, making this system a great option in regions with restricted water supply.

3. Like all systems described, because the **water is continuously**

recycled you will need to monitor for any signs of disease infestation. Regular water testing must also be done.

4. Plants in this system might be more **susceptible to ambient temperature**. Because the roots are not constantly submerged, high ambient temperature and water temperature might stress the crops. To mitigate this, opt instead for heat-tolerant plants like tomatoes.

Consulted source: https://www.howtoaquaponic.com/designs/dutch-bucket-aquaponics-system/



Dutch Bucket Systems

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