THE AQUAPONICS ANSWERS BOOK

HOW TO RAISE TILAPIA & GROW TASTY VEGETABLES

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The Aquaponics Answers Book

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By Rebecca D. Powers

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Introduction

Welcome to the world of Aquaponics where you have the ultimate in food control.

While I'm a lover of gardening and growing our own food, one has to admit that unless you are a vegetarian or vegan, you may want some healthy food diversity.

Now, I'm not just talking about the diversity you get from planting dozens of varieties of fruits and veggies… I'm talking about meat.

When it comes to raising your own meat, many tend to think about raising cattle, chickens, goats, rabbits and more. While that is great too, they do require more work …and the harvesting and cleaning of the animals is more than most can take.

But don't be dismayed. Aquaponics gives you a sure-fire turn-key food production system where you can grow just about every fruit and vegetable your stomach desires while simultaneously growing delicious, tasty and healthy fish you can continue to harvest.

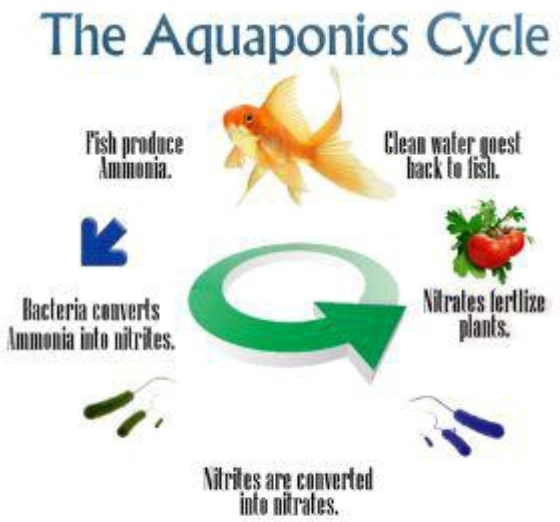
This book covers what I've learn from engaging in Aquaponics first hand. So no, this isn't a college research project. This book comes from me as a lover and practitioner of Aquaponics.

That said, having read many books on Aquaponics which inspired me in the first place, I did find some critical items to be lacking.

I didn't even know those things were missing until I found myself trying to figure them out myself.

So I hope you enjoy this journey into the wonderful world of food self-sufficiency via Aquaponics.

As we get started, the image the follows is a snapshot of how Aquaponics works. We will get into the details as we progress.



So let's begin…

The History of Aquaponics and How Aquaponics Works

Twenty-first century Aquaponics is the practice of raising fish and vegetables together in a symbiotic recirculating system. It is a marriage of hydroponics and aquaculture in which fish produce fertilizer that replaces the expensive chemical fertilizers used in hydroponics. In return, the plants clean and oxygenate the water to make it suitable for the fish, replacing expensive filters and aeration equipment used in aquaculture.

History

The Aquaponics movement may seem to be a strictly 21st century movement, and its popularity in the western world is certainly limited to our time period. However, Aquaponics does have ancient roots in the Americas and in Asia. We also see that Aquaponics is a part of nature.

In Nature

Aquaponics is at least somewhat a rediscovery of common sense principles exemplified in natural ecosystems. We see aquatic plants cleaning water for fish and we see that those plants growing because they are fertilized by fish waste. Whenever the water system is a moving one, such as a flowing stream we see a model for the circulating water in Aquaponics.

In the Americas

Some of the principles of Aquaponics were practiced by the Aztec Indians over 1000 years ago. Aztec farmers built soil covered rafts called chinampas and floated them in Lake Tenochtitlan. It was this sort of ingenuity that led to their great and rapid advancement as a civilization. Further the rapid growth of food from this source at least partially explains their ability to support a large populated city.

In Asia

South China and Thailand also practiced a form of Aquaponics early in their history, when they raised both rice and fish in the same paddy fields. As in modern Aquaponics, the fish provided fertilizer for the rice and the plant roots purified the water.

The Recirculating Aquaponics System

While Aquaponics has ancient roots, the modern Aquaponics system with closed loop recirculation is a very recent invention. The first re-circulating Aquaponics system was built in the 1970's, by Mark McMurty, a student of the New Alchemy Institute and also a student of North Carolina State University. Mark McMurty's systems and others developed from his work were used to produce food in many arid third world countries, but the popularity of Aquaponics in the U.S. and Canada is strictly a 21st century phenomenon.

How 21st Century Aquaponics Works

Aquaponics incorporates a series of vessels. The vessels are of two purposes. One type of vessel is intended to contain growing young fish and another type contains growing plants. Plant containers must be filled either with specialized Aquaponics media, generally in the form of rough clay balls, or with pebbles. The plants are planted in this soilless medium. Vessels are connected to each other with a network of PVC plumbing pipes.

The Path of Water

Optional Filtration

Water and fish waste are pumped from the fish tank through a pipe. The water can be passed through a smaller container containing some loose fiber materials to remove excess solids before it flows into a network of plant containers. This need not be anything fancy. A little polyester pillow stuffing in a bucket or large jar works well. This lightly filtered water then flows into the plant tanks. In the more efficient, flood drain systems the vessels that contain plants are gradually flooded. When they reach the ideal levels, a bell siphon is incorporated to drain the plants. Thus the plants are not constantly immersed in water. Instead they are watered and then allowed to dry before being soaked again. This is the natural cycle that most plants prefer. Once the water has been filtered through a series of plant vessels it is returned to the fish tank vessel.

Variations

Not all systems use bell siphons and a flood drain strategy. Some systems flow constantly. In addition, floating rafts may be incorporated for plants that need more constant watering, much like the Aztec chinampas, these rafts can be placed directly on the surface of the water of the fish tank. Unlike chinampas, they contain no soil. Aquaponics systems do not incorporate any type of soil. There are actually many ways to design an Aquaponics system. Different types may work better with different applications and require varying levels of expertise and experience.

Aquaponics Benefits and Types of Aquaponics Systems

In recent decades, we are faced with a need to grow more food on less land. In addition many forward thinking individuals want to establish individual, family and community food supply independence. While commercial farming relies increasingly on GMOs, complex processing and transport of food over great distances, many people feel it is more sensible for families and communities to produce their own organic foods, using heirloom seeds rather than genetically engineered plants.

Production and Efficiency

Aquaponics is the most efficient means to raise the maximum amount of food in a small space. There are several reasons why Aquaponics is so efficient. The first reason is the fish. A fish fed one pound of food will produce one pound of meat. By comparison, a cow must eat eight pounds of food to produce one pound of meat. As an added benefit, most species of fish will mature to suitable eating size in six to nine months. The second reason Aquaponics produces so efficiently is due to the superior fertilizer produced by the fish which causes plants to grow faster and more prolifically. The third reason is due to the efficient use of water as a resource.

Efficient use of Water

Aquaponics is superior in water use efficiency to traditional gardening, hydroponics and aquaculture because it does not waste or contaminate water. Instead water is re-circulated and used over and over. The only water that needs to be replaced is the water lost in evaporation or the occasional leak.

Self-Sustaining

Aquaponics requires no fertilizer, no pesticides and minimal equipment. The only absolutely necessary electric or mechanical element of the entire system is a

small water pump capable of raising a steady stream of water up a pipe to a height of approximately three or four feet above the water surface. A fountain pump or even a large aquarium pump is sufficient. The only other equipment that may be necessary is a heater, either for the water or in the green house.

Milwaukee Success

A forward thinking city, Milwaukee grasped the potential of Aquaponics before most of the U.S. A non-profit organization called Growing Power started Aquaponics farming there as early as 1993, making them a pioneer in the field. Their urban farm boasts the production of one million pounds of food on three acres annually, including 10,000 fish each year.

A Variety of Food

It's also important to note that Milwaukee's urban farm produces a variety of foods, not just one crop. Their Aquaponics greenhouses grow year around, even in Milwaukee winters, producing diverse foods like Portobello mushrooms, various greens, onions, melons, lettuces and tomatoes. They grow enough variety to actually support a population, with a widely varied balanced diet.

3 Basic Types of Aquaponics Systems

While there are virtually unlimited variations of Aquaponics systems limited only by the designer's creativity, all Aquaponics systems to date fall into three basic categories. It is also possible to build systems that incorporate two or more of these styles of systems in the same system. Again, creativity and experimentation can lead to a lot of versatility.

1. Nutrient Film System

The nutrient film system does not incorporate planter vessels, grow medium or pebbles. Instead a nutrient film system consists of a filter, and a large network of PVC pipes. Holes are drilled in the top of the PVC pipes and a plant is inserted into each hole. The flow of water is a constant circuit, going from the fish tank through the network of pipes and back to the tank. The only interruption of flow is a filter tank to remove solids. This is necessary to prevent a buildup of solids on the roots. The only disadvantages of this system are the constant soaking of plant roots and the absolute necessity of filtering out solids.

2. Deep Water Raft System

In this type of system the plants ride on a foam raft floating in the fish tank and are contained in netted pots. This idea is very simple and can be incorporated easily. Unfortunately the Styrofoam raft may block oxygen that would otherwise penetrate the water's surface. In addition the water does not circulate so aeration is decreased. Additional aeration may be required if this is the only Aquaponics aspect of the system.

3. Flood and Drain Systems

Most Aquaponics farmers prefer the flood and drain system. This system requires a network of grow bed vessels connected with PVC pipes and incorporating bell siphons for the purpose of flooding the grow beds to capacity and then draining them completely back into the fish tank. Most discussions about types of Aquaponics systems stems from variations in the configuration of flood drain systems.

CHOP Flood and Drain

The CHOP system configuration is the practical workhorse flood and drain configuration. CHOP is an acronym for Constant height one pump. The CHOP system features grow beds of all the same heights that are not substantially higher or lower than the fish tank. In a CHOP system, the sump tank, if present, is usually under the grow beds.

Barrel Phonics Flood and Drain

A Barrel Phonics System is an Aquaponics

configuration style developed by Travis Hughey in 2003. The system is constructed of plastic drums and features a strategic height variation. The fish tank is at the bottom, while the grow beds, constructed of two halves of the same plastic drum, are higher than the fish's water surface and usually hang over the top of the fish vessel so that in the event of a malfunction all water drains to the fish. A sump tank towers over the grow beds.

Customized Systems

There are many variations of these basic themes and ideas. Systems with more than one pump can facilitate multiple fish tanks. Adding a sump tank can improve filtration and reduce solid waste in the system. Creating grow beds on different levels or incorporating elements from raft or nutrient film systems or other water feature style elements can make an Aquaponics system both complex and beautiful. Incorporating decorative copper tanks, vertical PVC planters, huge glass aquariums or concrete fountain like configurations with water falls can make Aquaponics spectacularly beautiful. The creation of a unique Aquaponics configuration is only limited by the imagination. Most of the fun of an Aquaponics system is the limitless options in configuration and design that encourage constant improvements on already great systems.

Indoor Aquaponics vs. Outdoor Aquaponics

There are advantages to both indoor and outdoor Aquaponics. Aquaponics works equally well indoors and out because it is an extremely adaptable method of growing. The real decision between indoors and out usually rests almost entirely upon where there is the most space. It is also a decision based on location, climate, lifestyle, housekeeping habits and any number of other factors that may influence personal preference. That said each possible location has its advantages and disadvantages.

Indoors

One of the greatest advantages of indoor Aquaponics is the indoor heating system and protection from other elements like wind, snow, torrential rains and excessive heat. This climate control is hard to beat, but there are disadvantages as well. One disadvantage is often limited sunlight. This may require the incorporation of grow lights or placement near a large south facing window. Limited space and the necessity of displacing furniture and household storage to accommodate the Aquaponics system can also be a major disadvantage. Most people do not have a lot of unused space in their homes. Another problem some home owners have encountered is the need for additional floor supports to support the tremendous weight of water. A completely filled Aquaponics system can weigh hundreds if not thousands of pounds. It is very important to be aware of your home's construction and especially the size and placement of floor joists. Additional floor joints or added pillars under the house may be required.

Outdoors

The greatest advantage to an outdoor system is natural sunlight. In addition, there is the freedom from worry about collapsed floors and water damage from occasional spills or leaks. The greatest disadvantage is the weather, which isn't always warm and sunny. Heating a greenhouse can be expensive. Snow can collapse a greenhouse and high winds can blow them away. A greenhouse isn't necessarily required in warm weather, but in the winter and in colder climates a greenhouse is very helpful, because Aquaponics works best when used year around. Concerns about appearance are also less if the system will be outdoors. Gardeners will be free to make a mess, use salvaged materials and enjoy a wider range of creative license. There is an increased need to create a beautiful system instead of one that is simply utilitarian if it will be placed indoors or in a decorative garden area.

Sun Rooms and South Facing Window Walls

Perhaps the most ideal location for an Aquaponics garden is a glass sunroom or large window wall. This solution is the best of both worlds. The room is already heated, and sunroom glass insulates better than greenhouse plastic. There is even air conditioning to make it comfortable for gardeners. The need for a beautiful system is paramount in the sunroom, but that should not be a problem for someone with sufficient creative resources.

Greenhouse

A greenhouse is definitely an advantage, and makes winter gardening possible for those with outside systems. Heating will probably be required in most climates. It is possible to heat a greenhouse with compost, but it takes a lot of compost and still it isn't all that warm at night. If you are raising tilapia you'll need a thermostatically controlled heater for the water as well.

On the Lawn

In many climates a lawn oriented Aquaponics system works just fine. However if there is a chance of freezing, there are precautions that must be taken which can be quite inconvenient. Many people with small outdoor systems end up breaking down the system in winter and moving at least a smaller version of the system indoors.

Breaking down the system can cause problems with PH balance and makes it necessary to clean portions of the system not used all winter. Keeping a lawn system that can be moved inside for winter can be less than ideal but it does work.

Choosing a location for Aquaponics doesn't necessitate any one perfect solution. There are Aquaponics systems in basements that incorporate grow lights. It is still less expensive than heating a greenhouse. There are tiny apartments with small Aquaponics systems near a window or occupying a balcony or patio. Anyone can create an Aquaponics system virtually anywhere that can provide food for their family.

IBC Tote Aquaponics

One of the most challenging aspects of Aquaponics is finding readily available vessels to use for fish tanks and grow beds. We went with one of the simplest solutions which is the IBC tote. IBC totes are made of polyethylene IBC plastic and are surrounded by a supportive metal framework. The most commonly used tote is a 275 gallon capacity. The dimensions are 48" long, 40" wide and 46" high. They have a six inch diameter fill cap on top.

How to Set-Up an IBC tote System

Most people cut the top eight to twelve inches off for a grow bed and use the remainder as a fish tank. Both the metal frame and the polyethylene liner must be cut. The liner can be removed first to avoid puncture by removing the top metal bracing. The bell siphon can be plumbed by drilling a hole through the cap. Then just attach either a homemade or specialty plumbing siphon. Be sure to use plumbing tape and non-toxic silicon to insure the finished work is water tight. The most obvious solution is to stack the short grow bed on top of the tall fish tank. Most growers just turn the grow bed so that the 48 inch dimension of the grow bed overhangs the 40 inch width of the fish tank. This way when the bell siphon releases, the water simply drains back into the fish tank. Then all that is necessary is to place the pump so that it pulls water from the fish tank up into the grow bed. It's obviously the easiest solution.

This simple solution is great, but there is one small problem. It leaves only 8 inches of space to access the fish. Unless the grower plans to harvest all the fish at once and break down the unit completely, it is challenging to get the fish out to eat them. One can instead build a platform for the back of the grow bed to support it and offset it by as much as necessary for easy extraction of fish with a long handled net. One can if necessary also use a bit of PVC to direct the water from the bell siphon into the fish tank if necessary. Remember, it will be hard to move a filled grow bed, so it makes sense to place it where it can remain stationary.

Comparing Vessels

Choosing the right materials for an Aquaponics project requires careful consideration. It is part of the art, so to speak, to make a custom system that reflects the specific needs of each application. However food grade IBC totes are obviously among the best choices. When comparing any alternative type of tanks, one way to decide is to compare them to IBC totes. IBC totes are an ideal standard to decide if the vessel is superior or inferior for a specific purpose.

Cost

IBC totes vary considerably in cost. Some are used and it's very important to get food grade IBC totes that have not been used to store any sort of toxic materials. The cost of a used IBC tote varies from $20 to $100, though sometimes people can find them for free from food and beverage companies. New ones can cost between $500 and $1000 so it's a good idea to buy used. Often the best deals on these totes are in quantity buys. If you want a dozen two hundred gallon totes, you'll pay less for each one. A typical price on a reasonable quantity is 6 for $240. That's $40 each, and not such a bad deal.

Volume

It is important to remember that each fish will need about 5 to 7 gallons of water, or 5 gallons per pound of fish. Of course this is not an issue with fingerlings, but as fish grow they'll need more room. Also you should have one square foot of grow bed for every fish in order to filter the water correctly. A two hundred gallon tank should be able to support 40 one pound fish. Harvest of fish can began when they achieve approximately one pound size, leaving more room for growth in the remaining fish. Finding a larger vessel or including multiple vessels allows for more fish, but each tank needs its own pump. One may also want to incorporate additional grow beds to establish a good ratio of grow beds to fish.

Strength

Aquaponics fish tanks and grow beds must support the weight of the water. That is why IBC totes are supported by a metal framework. Other types of containers may require similar supports. It is possible to use plastic storage totes, including those pretty clear ones for raising tilapia hatchlings, or as additional grow beds, but it will be necessary to Support them with a substantial wooden, concrete or metal frame to prevent bowing sides.

Potentially Toxic

It is also necessary to find containers that are not toxic to plants or fish. Some but not all IBC totes qualify as good fish tanks and planters. It is important to get food grade totes that have not been used forchemical storage.

Overall Durability

It's important to remember that tanks and grow beds must withstand all their days in the sun. They must also contain a tremendous weight in water. The constant pressure and plastic degrading rays will take their toll on any container. Frequent inspection for brittleness is necessary with any plastic container but so far, the IBC totes seem to be holding up fine to the strain. Many people use them, with few complaints. When using other types of plastic containers one must be mindful that most will become brittle after a few of months in direct sunlight.

Alternatives

IBC totes are one of the best vessels for creating an Aquaponics system of grow beds and fish tanks. Other possibilities include old hot tubs, discarded bathtubs, existing in ground fish ponds, livestock watering troughs. Custom concrete systems coated with a non-toxic sealer are great for beauty and creativity, large diameter PVC pipes can also be incorporated, and plastic storage totes, which may break down in direct sunlight can be reinforced with a frame for housing baby tilapia in the shade. Custom tanks can be built out of aquarium glass, or built from safe metals like copper or stainless steel. Many of these are chosen for aesthetic purposes.

Setting Up Your Aquaponics System and Cycling Your Aquaponics System

There are many aspects to consider when setting up an Aquaponics system for the first time. Don't ever feel that your Aquaponics system needs to be like someone else's. It should be your own unique invention based on basic principles, the type of fish and plants you want and your own creativity. Look at a lot of different systems and borrow ideas from several sources to create your own system.

Cardinal Points

It is important to be aware of compass directions when setting up an Aquaponics system. The entire system must have sunlight coming from the south. The North side can be obstructed even by a solid wall, but the south side needs to be open to light. Place taller plants nearer the north, and shorter plants or plants on lower grow beds nearer the light source to avoid trying to raise plants in the shade. The only exception is plants that prefer partial shade.

Placing the Fish Tank

Fish tanks don't necessarily require sunlight unless you are growing duckweed or have a raft system on top. Duckweed is a plant that tilapia and many other types of fish can eat and defray the cost of food. Different types of fish prefer different water temperatures so consider this also when placing tanks. Tilapias prefer very warm water so placing these in the sun during the winter can help keep the water warm. Trout on the other hand need to be kept cool, shaded and well aerated.

Water Temperature

It is possible to create an in-ground or partially in-ground fish tank in order to help stabilize the water temperature. Water kept below the ground will stay warmer in winter and cooler in summer and that might save fish lives in the event power is lost in

the winter or during a scorching heat wave in summer. It's important to remember that water that is too warm can literally suffocate fish because oxygen levels drop when the temperature of water increases. Trout are especially susceptible to this problem because trout require a lot of oxygen, but any fish can suffer or die if oxygen levels get low enough.

Water Volume

Though many people use different plant to fish ratios it is a good idea to have one square foot of grow bed water to each fish and five gallons of water for each fish. For example a 200 gallon tank could contain 40 fish and need 40 square feet of one foot deep grow beds. Some systems vary from this formula without ill effects but for beginners this is the easiest system to maintain.

Check the Pump Specifications

Different pumps have different strengths and can only raise the water to a certain height. A typical pump can raise water up to four feet from the surface of the water. This is an important point to check when purchasing the pump and when setting up grow beds over fish tanks. Once you've considered all these points it will be easier to design your unique Aquaponics configuration. Any configuration is a network of grow beds and at least one fish tank. Remember each additional tank will require its own pump.

Basics

The water pumps from the fish tank and enters the grow bed(s). Plumbing can either split off into two equal grow beds via a T valve, or circulate to any number of grow beds one or two at a time, before reentering the fish tank. Plumbing can be done with PVC pipe in the same way one would do any other sort of plumbing. PEX pipe or plastic tubing could also be used, but there must be fittings to prevent leaks if water enters below the water level. Alternatively, one could allow each bell siphon to freely spill onto a planter below it as long as the lower planter is not shaded by the upper planter. It is often a good idea to have a spigot valve somewhere in the earliest part of the grow bed configuration to facilitate cycling.

Pumps and Plumbing

It's important for the water to be pulled from the bottom of the tank. Many people use submersible pumps but an external pump that pulls the water up may hold up better. The pump will pull up solid waste with the water, so a pump with a bit of filtering material is desirable. Next the water should travel to the grow beds. Either use a T valve to split the water flow or have grow beds flow from one to the other in sequence. There are sequence timers that can be installed to help regulate the flow of water from one bed to another, but the bell siphon can be used alone to regulate water flow.

Testing Water Volume

Once your system is assembled to your satisfaction, you'll want to fill it with water and start experimenting with the water flow. It may not work exactly as you imagined. If the water level in the fish tank goes down too much, you can add more water to the system. Ideally the water level should remain fairly constant in your fish tank, only going down by perhaps as much as 20 percent at the lowest point. This can be accomplished using multiple grow beds. A single grow bed will reduce the amount of water by the maximum capacity of the grow bed before refilling.

Cycling

When your system is set up, it will be very clean and bacteria free. While this sounds like a good thing, it really isn't. You'll need to attract specific bacteria to help break down the ammonia and nitrogen based compounds in your fish waste to the point your plants can use them up as nitrogen fertilizer. This may take time. For the first several weeks, you'll have to monitor the water carefully. It's possible to lose fish during the cycling process. For that reason, it may be best to use fish you don't care as

much about and which are very hearty. Tilapia or trout are not likely to survive this process. Many people use goldfish from a pet store to get through this process. A few catfish would probably be fine to get though cycling. Feed your fish sparingly, only once a day during the cycling process.

Cycling Equipment

Just as many other Aquaponics gardeners do, we use an API Freshwater Master Test Kit, like the one made by Aquarium Pharmaceuticals to monitor the ammonia, nitrate and nitrite levels. You'll also need a submersible thermometer to monitor water temperature and a digital dissolved oxygen meter. During the cycling process, you'll need to test the water frequently.

Maintaining PH

PH levels should be kept between 6.8 and 7.0 during cycling. If the PH rises above 7.0 start cycling the water. Discard water pumped from the fish tank and replace it with fresh un-chlorinated water. A good way to do this is to simply add un-chlorinated water to the grow beds while blocking the flow of fish tank water. This is why it's a good idea to have a spigot valve in your system. Introducing water to the planters rather than the tank allows time for the water temperature to adjust. Do this for quick intervals though, to avoid rapid change. If you have fish in your tank, the water PH must not change by more than 0.2 per day.

Tip:

I suggestion using [General Hydrophonics] PH Up or Down to control the PH levels without having to add water to the tank.

Testing Your Water Step-By-Step

STEP ONE: Collect water from tank with glass tube.

STEP TWO: Add 3 drops of the PH test solution directly into the tube.

STEP THREE: Shake well.

STEP FOUR: Compare the color to the PH chart.

STEP FIVE: If too low pour General Hydroponics PH Up direct in the tank and if too high pour General Hydroponics PH Down direct to the tank.

Dealing with Nitrite

Nitrite is the equivalent of carbon monoxide to fish. It is quite deadly. If Nitrite levels rise above 10 parts per million, cycling the water as described above may help but you may also need to add a bit of Celtic Sea to the water. Add one kg of salt per 1000 liters of water, and always dissolve the salt in water in a separate bucket before adding it. After three to five weeks you can relax a bit, but continue to monitor your system for these dangers. Building up the bacteria does take time. Some people use pond water to speed up the process of cycling, but unless you are sure that the pond has not been contaminated with chemicals and pollutants, it's probably better to just get through the process by building your own bacteria.

Dealing with Ammonia

When fish excrete waste they release ammonia into water. In addition fish waste the algae and decomposing fish feed also increase the ammonia level. Ammonia is toxic to fish in high concentrations, so it has to be removed from the fish tanks for fish to remain healthy. Biofilter action coverts ammonia to nitrite then to nitrate for plants to use and transfer clean oxygenated water back to the fish tank. It's very important to keep plants in your grow bed. In the event you want to get your system growing food immediately but your system isn't fully cycled, then you can add 1oz of Maxicrop to your tank each day to give your plants what they need. Maxicorp is harmless to your fish and nutrient rich for your plants.


Maxicrop

Types of Fish to Raise in Aquaponics

There are many species of fish, and probably most of them could be raised in an Aquaponics system, but the most common edible Aquaponics fish are tilapia and catfish. Some people use goldfish and koi which are not considered edible. Since this chapter is predominately about food production the focus will be on edible fish. Those interested should note that raising Koi and Goldfish is similar to raising catfish in many ways. That fish of our choice is…

Tilapia

As Food: Tilapia is one of the most common food fish raised in Aquaponics. It is a favorite because of its mild flavor, easy preparation and popularity as a healthy food fish. Even people, who are not usually fond of fish, like tilapia because it doesn't taste fishy.

Fish Food: Tilapia are omnivores, with a slight leaning towards herbivore. They are often content to eat duck weed almost exclusively. They are reluctant to eat young fish, even hatchlings, but they will eventually if the babies are not collected in a day or so.

Breeding: The ease of breeding Tilapia in captivity is also a tremendous bonus. Tilapia can be bred in a 55 gallon tank, with 4 females and two males. Alternatively they can be breed in a larger tank with more mating pairs, or should I say threesomes. Keep your ratio at two to one, females to males. Tilapia mothers hold their eggs in their mouths and care must be taken not to alarm them during this time. They will spit out their babies when they hatch. Tilapias are not shy about breeding, compared to other fish. You can watch. The females require pipes or cups in the bottom of the tank to hide in and to mate safely.

- Ideal Water Temperature: 74 to 80
- Tolerable Water Temperature: 60 to 95
- Oxygen Needs: Low
- Mature Size: 1.5 pounds
- Age of Maturity: 9-12 months

Catfish

As Food: Catfish are quite delicious but hard to debone and dress. They have a bit of a lowbrow image as well. Still, Catfish are very hearty, and not picky about water temperature or dirty water. Their oxygen needs are modest. For these reasons they may be a good first fish for beginning Aquaponics gardeners.

Fish Food: Catfish are omnivorous and in their case this means they will eat anything voraciously. They like worms, bugs or commercial fish food. While there are a lot of things you could feed your catfish, keeping the water clean prohibits feeding them table scraps. They also eat vegetation including duck weed, but probably need at least some meat, such as red wigglers. Most people who raise catfish also raise red wigglers to feed them.

Breeding: Unless you have a large pond, you'll not be able to breed catfish. Catfish are picky about mating and won't breed unless they are sure there is enough room for all the babies. They will not breed in a tank or allow people to observe them. They will only breed in the crags and holes on the edges of sizable fish ponds.

Water Temperature: Catfish can endure nearly any water temperature found in nature. As long as they aren't literally frozen or boiling they should be fine. Catfish routinely survive beneath the surface of frozen over ponds. Of course they can't survive being frozen solid, but short of that, they will be OK.

- Oxygen Needs: Low
- Mature Size:1.25 pounds
- Age of Maturity: 6-12 months

***Note:** Catfish like to jump up out of the water more than most fish. They are high jumpers. For this reason it is very important to either cover their container with screen, or put a retaining net high around the opening of the tank to keep them from jumping out.

Perch

As Food: Perch may not be an all-time favorite, but they are a tasty edible fish, easy to clean, dress and filet. Perch are especially rich in Omega 3 fatty acids.

Fish Food: Perch are carnivores. They like bugs and worms.

- Water Temperature: Virtually anything short of frozen to 89 degrees
- Ideal Water Temperature: 70 to 75 degrees F.
- Oxygen Needs: Low
- Mature Size: varies from 4 ounces to 1 pound
- Age of Maturity: 12 to 24 months

***Note:** Perch tend to be small when crowded or kept at cold temperatures. They are also slow growers. Their growth rates are definite downsides to their use in Aquaponics, but otherwise they are hearty fish and easy to care for.

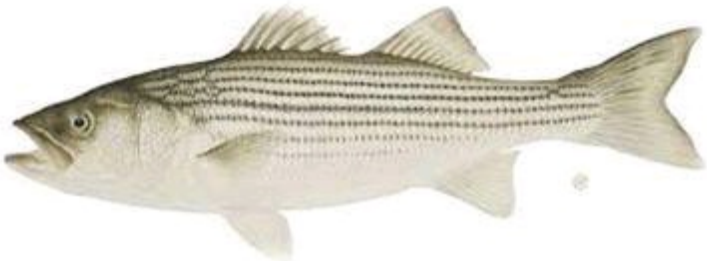
Trout

As Food: Trout are among the most delicious fish in the world. Rainbow and brook trout are among the most sought after varieties but other breeds are also tasty. Dressing a trout is very simple and bones can be left in, or the fish can be filleted. The traditional way to serve trout is whole, pan fried with bone in, but of course it must be gutted.

Fish Food: Trout are Carnivores. It would be a good idea, if you are going to raise trout to also raise earth worms, such as red wigglers.

Special Conditions: Trout are native to swift mountain streams and require highly oxygenated cold water. They require aeration and prefer a current. Creating a trout habitat requires a good bit of expertise and creativity, but it can be done. It's not a good beginner Aquaponics project though. After trying Aquaponics for a few years and experimenting with different styles of fish tanks and habitats, it would be extremely fun to try raising trout, perhaps as part of an elaborate continuous flow nutrient film system rather than a flood and drain system.

- Ideal Water Temperature: 55 to 65
- Tolerable Water Temperature: 38 to 68
- Oxygen Needs: Very high
- Mature Size: 0.8 pounds
- Age of Maturity: 12 months



Bass

As Food: Bass is a game fish. It's easy to clean and good to eat.

Fish Food: Bass are strictly Carnivores they like worms and bugs. Raising red wigglers or other worms and insects would be a must.

- Tolerable Water Temperature: 40 to 90
- Ideal Water Temperature: 74 to 80
- Oxygen Needs: Low
- Mature Size 1-3 pounds
- Age of Maturity: 15 to 18 months

How To Feeding Fingerlings Organic Feed

Although you can start your fish on fingerling food we were hard pressed to find organic fingerling food. So therefore we purchased organic feed and ground it down to mix into the starter feed. Here's how you can use organic feed for your fingerlings until they get big enough to eat the pellets as is. We use AquaOrganic feed it contains no GMO, fish meal or soy.

STEP ONE: Measure out the appropriate feed amount.

STEP TWO: Using a small mixer like magic bullet grind your feed till is sand like fine.

STEP THREE: Attach blender blade to magic mixer then hold down to start the mixing process**.**

STEP FOUR: Mix till you see that the feed is ground fine like sand.

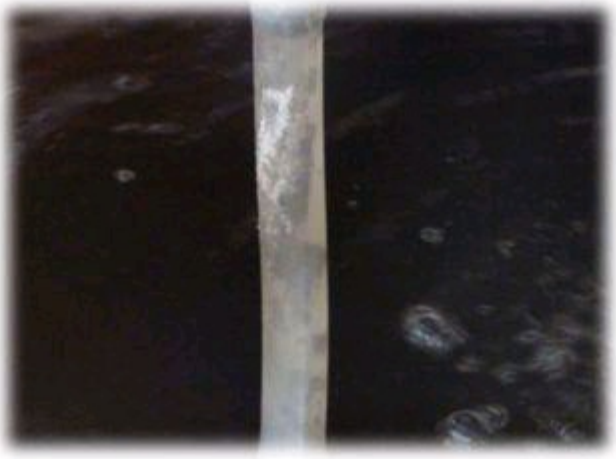
STEP SIX: Feed is now ready for your fingerlings. Add to the tank.

Figure 1 of 3

Figure 2 of 3

Figure 3 of 3

Cleaning Your Pump Hose – Step-By-Step



Here's how we clean the connected water pump hose each month. **Supplies needed water and tube brush.**

STEP ONE: Unplug the pump from the outlet.

STEP TWO: Disconnect tube from pump.

STEP THREE: Wiggle side to side to remove tube from the drain.

STEP FOUR: In a sink run water from one end of the tube.

STEP FIVE: Grab your tube brush and insert into one end of the tube and begin to push down the grime.

Figure 1 of 2

Figure 2 of 2

STEP SIX: Once you have the soiled material pushed down as far as you can go add more water to the clean end of the tube.

Figure 1 of 3

Figure 2 of 3

Figure 3 of 3

STEP SEVEN: Turn the tube over to the dirty side, insert your brush and begin to push the soiled material back out towards the cleaned side.

Figure 1 of 3

Figure 2 of 3

Figure 3 of 3

STEP EIGHT: Add water to both ends of the tube to remove the remaining residue.

Figure 1 of 6

Figure 2 of 6

Figure 3 of 6

Figure 4 of 6

Figure 5 of 6

Figure 6 of 6

STEP NINE: Connect hose to drain.

STEP TEN: Connect hose to pump.

Figure 1 of 2

Figure 2 of 2

STEP ELEVEN: Re-submerge pump into water your system will pick right up from where you left off.

STEP TWELVE: Reconnect the power to your pump.

Figure 1 of 3

Figure 2 of 3

Figure 3 of 3

How To Deal With Stressed Fish

Celtic Sea salt can be used if you notice that your fish are distressed such as not eating as rapidly and exhibiting low energy.

STEP ONE: Pour 1/3 cup of Celtic salt into a small bowl or plastic container.

STEP TWO: Use water from the tank to dissolve the salt.

STEP THREE: Stir salt and water well.

STEP FOUR: Pour salt mixture back in the tank.

Black Soldier Fly Grub Composting

Like most species of fly, the black soldier fly grub feeds on decaying organic matter. Unlike normal flies, its favorite food is compost. If you have or plan on building your own Aquaponics system take advantage of this trend. Composting with black soldier fly grubs allows you to produce quality compost and provide your fish with an excellent food source. Here are some of the amazing benefits.

Superior Nutrition. The animal protein contained in commercial fish foods are often derived from ground animal by-products and preserved with harmful chemicals. This is not ideal nutrition and there is some concern over the possible health effects. Supplementing your fish's diet with soldier fly grub is a better choice. Besides being all-natural, they are also nutritionally superior. Here is a breakdown of their nutrient content:

- 35% crude fat
- 42% crude protein
- 7% crude fiber

- 1.5% phosphorus
- 8% moisture
- 14.5% ash
- 5% calcium

These figures are more than sufficient to meet the nutritional needs of fish. Fish fed with these grubs can be healthier, grow faster, and have more energy and improved resistance to disease.

Cost-Effective. After an initial investment of a starter colony and a suitable composting bin like the BioPod Plus, you will have a free source of quality fish food. These insects replenish themselves quickly and in large numbers. Although adults live for only three to four days, a single female will lay around 900 eggs in that time. Depending on the size of your setup, you could receive several cups of these wonderful little grubs each day. This can help you save a lot of money on feed. My newly  arrived BioPod Plus!

Food goes in the top circler opening; add soldier fly larva. They feed on scraps and when they are ready to harvest, they crawl up and drop into the collection chamber where you can feed them live to the fish or freeze them for later.

STEP ONE: Place food scraps in biopod.

STEP TWO: Add black solider flies.

STEP THREE: Watch as they devour the scraps multiply and harvest themselves!

Multipurpose. Although black soldier fly grubs make a convenient and cost-effective food source, they provide other benefits as well. Their rapid reproduction and large appetites make them a friend of any home composting project. This means that your garden will also benefit from their use. Within a short time, a colony of black soldier grubs will reduce kitchen scraps, yard waste, chicken bedding and animal droppings into rich compost. You can also collect the watery byproducts of the composting process and dilute them to half-strength to make a liquid fertilizer.

Planting in Aquaponics

Aquaponics planting is a widely varied topic because there are so many options involved. We'll try to keep this basic but it's important to remember that almost anything can be grown in Aquaponics. There are a few things that it's better to grow elsewhere though. Potatoes and yams are much easier to grow in a laundry tub full of soil, elsewhere in your greenhouse. Corn is just too tall and the roots of corn are really long. It's easy enough to grow corn in a very ordinary way, outside. Other than that, almost anything will grow in Aquaponics grow beds.

Grow Mediums

As you know, Aquaponics is completely soilless, so what can we grow our plants in. Many people use expanded clay or expanded shale medium others use rounded gravel. The gravel has to be limestone free in order to avoid raising the PH. Whatever you use; you'll need a lot of it. You'll be filling all your grow beds about one foot deep in medium. Choose something you can buy or make in quantity. You may have a better and more creative idea for medium than the usual types. Remember, with Aquaponics it's OK to be creative as long as you stick to the basic principles.

Your Media must be:

- Porous
- No sharp edges to cut fingers
- Be free of limestone or lime
- Half to three quarters of an inch in diameter for each

piece

- Inert and not leach chemicals.
- Must not decompose

Planting Seeds

For most varieties of plants, it is easiest to plant seedlings but it is possible to plant lettuce, greens or carrot seeds by just sprinkling them in. Larger seeds need to be sprouted separately.

Incubator

While many people sprout seeds in water or between wet paper towels, it's easiest to germinate most seeds and especially tomato seeds in a plant incubator. A good plant incubator need not be expensive. They can be purchased on line for as little as $25 and they work wonderfully to get the most from your seeds. It's permissible to sprout them in soil. Plant seeds close together, allow them to grow to about an inch or two in height and then pick them apart and plant them in the grow medium. Alternatively you could plant them in small trays or grow pots to allow them to mature a bit before planting them in the system.

Plants Ready To Set Out

It's also possible to plant bigger plants from the garden shop. Just wash the excess dirt off the root ball and plant them in your grow medium. Pepper plants, tomatoes and squash are often sold in groups of four or six already growing plants intended to be set out in gardens. These work just fine if you remove most of the potting soil.

Choosing what to plant is as simple as deciding what you like. Strawberries, carrots, lettuce, tomatoes and greens are all excellent crops for Aquaponics. Here are a few specific tips.

Tomatoes and other vine plants will need to

be staked, so trellis materials may need to be attached to grow beds.

Strawberries work well in vertical PVC pipe planters. You can find instructions for creating vertical planters out of PVC pipe on line.

Melons can also work if you can rig supports for the large heavy cantaloupes, watermelons and honeydews. The trick is to root the plant in the grow bed and allow the vines to rest outside of the bed on a strong wood or metal framework.

Herb gardens are great in Aquaponics beds. Many home cooks like to have a tiny Aquaponics system that incorporates an aquarium and a small grow bed for an herb garden.

Grow kale, collards and other types of greens all winter long. Often greens will grow during off seasons when other plants slow down.

As with other aspects of Aquaponics, planting is only limited by imagination. Get creative and you'll find that planting can be a lot of fun.

Tip: The following illustrations will detail how to broadcast seeds and transplant herbs or vegetables into you're grow bed.

STEP ONE: Select your seeds of choice. We are a big fan of Heirloom Organics they offer a wide variety of organic seeds that are "100-percent non-hybrid, non gmo seeds; save your seeds and never buy them again; enough seed to plant, save, barter and trade".

STEP TWO: Pour seeds into the ball of your hand.

STEP THREE: Broadcast the seeds on top of grow medium and gently spread across the grow medium.

Day 1 after broadcasting seeds.

Day 2 after broadcasting seeds.

Day 3 after broadcasting seeds.

We noticed new fingerlings on Day 2 of broadcasting. This will be our 2 batch the 1 batch we decided to leave them in the tank and before we knew it they were all eaten. Here are some quick steps on saving them.

STEP ONE: Prepare a new home for your fingerlings using the same tank water.

STEP TWO: Scoop them up with a small fish net. They are fast to be prepared.

STEP THREE: Drop them into their new safe environment.

Transplant herbs or vegetables into your grow bed. Make sure the roots are free of soil.

STEP ONE: With your plant in one hand use your free hand to dig in the grow medium and create a pocket for the plant.

STEP TWO: Moving your hand in side to side motion and gently work the roots in to the grow medium.

STEP THREE: Secure your plant with additional grow mediums and your transplant is now complete!

Figure 1 of 2

Figure 2 of 2

Tip: If you notice that your vegetables are yellowing this can be corrected with Iron Chelate. It's organic and great for indoor and outdoor plants. Dilute in spray bottle and spray the plant leafs.

Note: Adding Red Wiggler worms to the grow bed is instant worm team for your plants. Worms feed on all the waste within the grow beds and in addition the produce their castings then fertilize the plants in the

grow bed. Instant worm tea! Although I was only able to capture two worms for the photo below there are over 1,000 red wiggler worms in our grow bed.

Monitoring & Testing Your System and Common Issue & Solutions

One reason Aquaponics systems are such a joy is because they require relatively little maintenance under normal conditions. Compared to daily hoeing and weeding it's really easy to garden with Aquaponics.

Easy to Maintain

Once your system has been cycled until it is stable, maintaining an Aquaponics system becomes very simple. Most people check on their system daily, feeding the fish and insuring that everything seems to be working. If the PH has been stable and there's no nitrite build up, once a week is often enough for testing. If your PH goes up or the nitrites increase you'll have to cycle a bit. You might even have to add a bit of pool salt. The process is the same as cycling at start up.

Temperatures and Oxygen

Sometimes in summer the water will get too hot and cause the oxygen levels to drop. One of the best ways to cool things off and add oxygen to a system is with falling water. One can simply allow the water to pour from a distance such as from a grow bed to another grow bed or from a grow bed into the fish tank. It's also possible to create more elaborate waterfalls, similar to those found in outdoor water features. Again use your imagination to improve your configuration. It might be best to change your configuration between summer and winter with more waterfalls in the summer.

Wintertime Worries

One of the greatest concerns of Aquaponics is heating the greenhouse. As you know, plastic isn't the greatest insulator and running an electric heater can get very expensive. Still, both water and air must be kept warm. Tilapia will die if the water gets below 50 or 55 degrees. While Catfish, bass and perch are heartier when it comes to weather, they will freeze if the water freezes. Cold water on their roots will also stunt or kill the plants more surely than cold air.

Wintertime Solutions

Insulation

While you can't very well cover your greenhouse with fiberglass or spray foam, you can easily build in the north side and apply insulation to that north wall. It's also possible to build a small room on one end of the green house to shelter your most delicate fish and plants. Two layers of plastic on the greenhouse might also help, especially if it's possible to create an air space between them. Some people build greenhouses out of plastic bottles to create airspace. It would be possible to place used plastic bottles between two layers of plastic across the roof of the greenhouse. It's also possible to insulate the outside of your fish tank and grow beds. This works really well with heated water.

Heat sink Principles

Plastic bottles filled with water can create a water heat sink. Lining the walls with plastic milk jugs full of water can make a huge difference in temperatures inside the greenhouse. The bottles will be warmed by the sun during the day and hopefully hold that heat throughout most of the night. The same principle applies to larger tanks of water, including your grow beds and tank.

Getting into Hot Water

Heating the water is an even better solution, except that it takes a lot of electricity. You'll need one watt for every liter of water in the fish tank. That's quite a lot, but it is still more effective than just using an electric space heater because the water holds warmth much more than the air in the greenhouse. Getting creative with water heating can be interesting but also risky. While it is certainly possible to heat water using other methods than electricity, it's important to be able to regulate the temperature. The last thing you want to do is overheat the water. Hot water can kill both fish and plants, so be careful if you plan to use something that doesn't have a thermostat.

Decorate with Black

Black absorbs and holds heat, while white reflects heat. It's a good idea to paint stuff black, cover the floor with black landscaping fabric and drape as much stuff as possible in black plastic or fabric. Wrap your water tank in black material to make it absorb heat during winter.

Smelly Solutions

Compost is a great source of heat. Stir it frequently, make sure it has a high PH and the compost will get hotter. This helps keep your greenhouse warm. It is ironic that the very chemicals that would kill our fish if it were in the water, can keep them alive if they are part of compost. Keep your compost high in nitrogen.

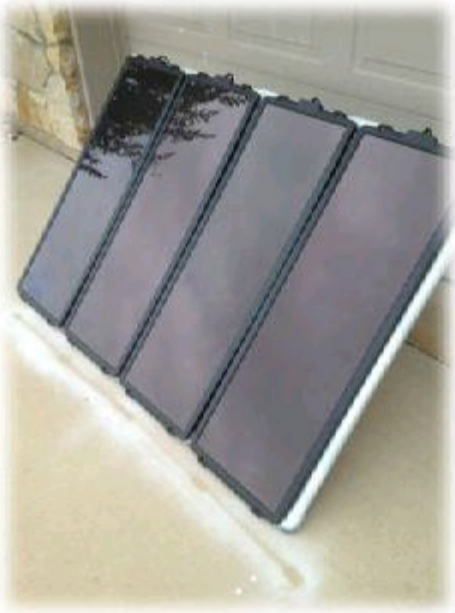
As you work with your Aquaponics system you are certain to encounter challenges. You can find solutions for most of these problems on line, or you can find your own answers. Plants may wilt, bugs might invade and fish can die, but through it all, if you use your wits and use your creativity you'll be able to come up with solutions. Aquaponics not only grows plants and fish it also grows the mind, enhances creativity and sharpens problem solving skills.

Note: Keep water warm with a **Pro Heater** and monitor water temperature with HDE LCD Fish Tank Thermometer.

Heater

HDE LCD Fish Tank Thermometer

Conclusion



Aquaponics is one of the best ways to grow fish and vegetables at the same time without using a ton of space. Of course you can get really creative and build a huge system in your backyard or garage. However, in terms of being self-sufficient you can't beat the rewarding benefits Aquaponics has to offer. Another way to add to your self-sufficient lifestyle of breeding fish growing vegetables and feed with your BioPod will be powering your Aquaponics system with solar.

We like to store pre-filtered

water for our tank using Good Ideas Rain Wizard 50-Gallon and BMS Garden Hose Filter. Below is the step-by-step process on how we do it.

STEP ONE: Connect BMS Garden filter to hose

STEP TWO: Place in barrel and fill it up.

Water is then pumped out of the Good Ideas Rain Wizard by solar pump into the fish tank.

And there you have it, my small contribution to the world of Aquaponics.

I hope you feel the contribution was worth your time to explore. If so, please be so kind to rate this book and leave me your feedback on Amazon.

Just as I have been inspired by those in Aquaponics who can before me and left a document of their knowledge in their books and videos, it's my hope that I have been equally inspiring to you.

Aquaponics is a get out of the "toxic food jail" card. It really is the best system on the planet for controlling your food in small spaces and large spaces alike.

Aquaponics gives you an unprecedented food freedom that ensures you and your family are no longer a prisoner of the poisons being pushed on the public.

And it's fun!

Not only is Aquaponics fun, its low maintenance requiring just a few minutes of your time each week.

Heck, you'll spend more timing eating the food you produce from your Aquaponics system then you will on time maintaining your system.

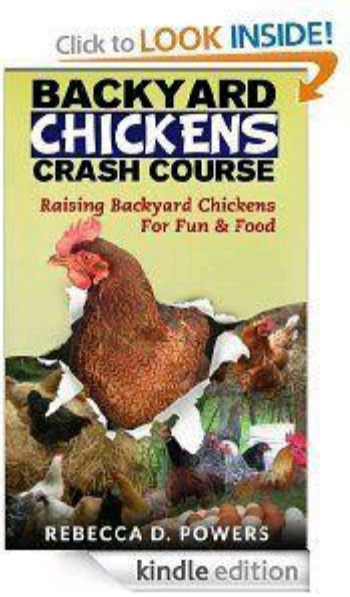
Thank you for allowing me to have both your time and attention to go on this journey together.

May you and your family's plates be filled with fresh veggies and fresh fish forever from your own Aquaponics system.

Enjoy your journey… and just as important, enjoy your food.

Rebecca

Available Now For Kindle by Rebecca D. Powers



Backyard Chickens Crash Course - Raising Backyard Chickens For Fun & Food

By Rebecca D. Powers

Check out this app by 4 Gardeners By Gardeners (4GbG). This is where gardeners of all levels can join in on the conversation by submitting short articles on their growing experience.

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