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Aquaponics - What you need to know

Introduction

When it comes to gardening and growing your own food, few technologies have a stronger potential impact on self sustainability and healthy living than aquaponics. In a world stricken with poverty, this technology, if implemented correctly, could help shift the masses from dependency to self-reliance which could affect us all on a global scale by ending world hunger.

The reason is because through this method of food production there is no easier way to become completely self-sufficient while eating healthy, organically grown fruits and vegetables. It may seem complicated or overwhelming but it's not as difficult as it sounds. Once your system is up and running, all it takes is a little "aquarium" maintenance to keep it going for the season or for years and years if you like.

Aquaponics is not dependent on the weather or climate (within a temperature controlled greenhouse), which means you can do this just about anywhere. *Some people are growing their food year-round (even in the Colorado winter climate) in greenhouse domes kept warm by efficient wood burning stoves.*

Aquaponics is not dependent on soil composition or rainfall and it doesn't require a lot of space because it doesn't require soil. Water is also conserved because it is recirculated an reused rather than lost through evaporation.

The benefits are numerous and will be explored in later chapters but for now, let's answer the question to...

What is aquaponics?

I. Aquaponics - a brief history

Aquaponics is generally believed to have originated in the early Asian and South American civilizations.

The Aztecs created islands on lakes and canals on which the cultivated food plants using nutrients derived from the mud and waste materials.

The ancient Chinese integrated aquaculture into their farming by raising fish in the rice paddies.

Flash forward to the 20th century and you will find prominent pioneers who are credited with the "modernization" of aquaponics as it is today.

The following is from the wikipedia reference on aquaponics:

http://en.wikipedia.org/wiki/Aquaponics

"While the development of aquaponics is often attributed to the various works of the New Alchemy Institute and the works of Dr. Mark McMurtry et al. at the North Carolina State University, many papers of initial development of aquaponics concepts pre-date both institutions by nearly a decade.

Inspired by the successes of the New Alchemy Institute and the North Carolina State University with aquaponics, other institutes followed suit. Besides the reciprocating aquaponics based on the techniques developed by Dr. Mark McMurtry et al. at the North Carolina State University, Dr. James Rakocy and his colleagues at the University of the Virgin Islands researched and developed the "Deep Water" or "Raft Culture" aquaponics. The system combines tilapia with various vegetables.

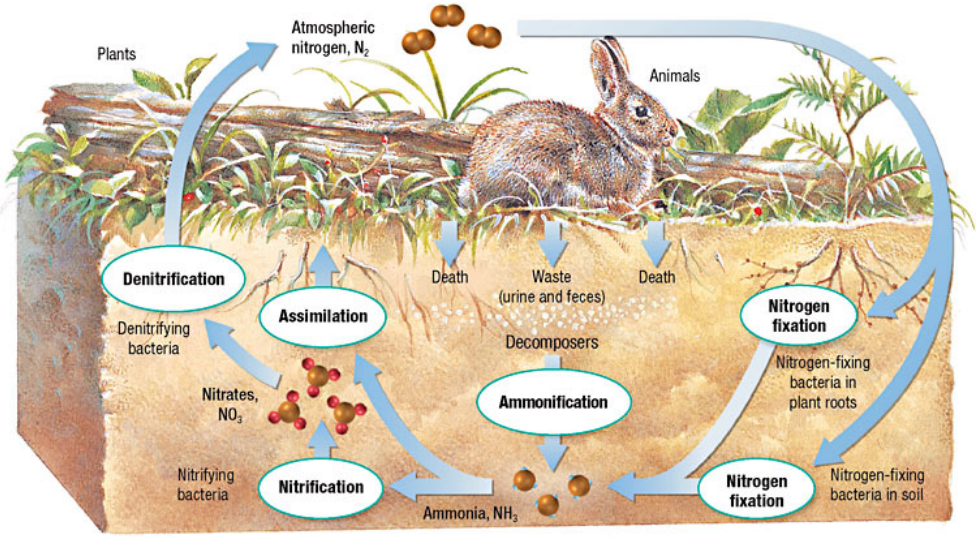
In 1997 Rebecca L. Nelson and John S. Pade began publishing the Aquaponics Journal, a quarterly scientific journal that brings together research and various applications of aquaponics from around the globe.

The first aquaponics research in Canada was a small system added onto existing aquaculture research at a research station in Lethbridge. Canada saw a rise in aquaponics setups throughout the ’90s, predominantly as commercial installations, that for example combine trout with floating lettuce production, or to water fruiting vegetable crops that warm up the water too much to be recirculated back into the fish ponds. Eels are also known to be raised. A setup based on the deep water system developed at the University of Virgin Islands was built in a greenhouse at Brooks, Alberta where Dr. Nick Savidov and colleagues researched aquaponics from a background of plant science. The team made findings on rapid root growth in aquaponics systems, on closing the solid waste loop, and that because of certain advantages in the system over traditional aquaculture, the system can run well at a low pH level, which is favored by plants but not fish. The Edmonton Aquaponics Society in Northern Alberta is adapting Dr. Savidov's commercially sized system to a smaller scale prototype that can be operated by families, small groups, or restaurants. They intend to further develop the closed solid waste loop."

-end of wikipedia reference

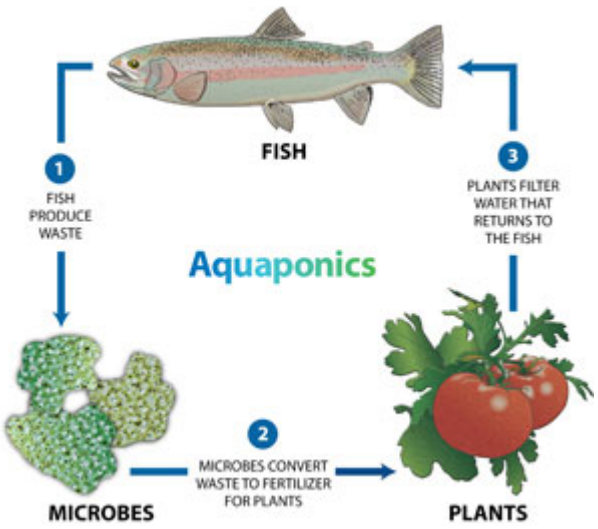
II. How aquaponics works - the basics

Aquaponics is the process by which plants are grown hydroponically (without soil) while being fed nutrients from fish waste. It is the natural cycle found in nature brought to it's simplest form. It has been proven to work when done properly and is the most efficient way to grow organic food.



The nitrogen cycle as found in nature.

The process by which fish waste (effluent) is broken down by bacteria into nitrites and nitrates which the plants can use is called the nitrogen cycle. In nature, organic matter decays and mixes with the soil. Bacteria breaks it down into simple forms that plants use for food—It's the same reason farmers use fertilizer in the soil. Aquaponics simply takes the hard work out of the equation. All that's required once the system is set up is feeding the fish and some water maintenance. The system cycles itself on it's own time naturally and can operate year-round in the proper climate.



The nitrogen cycle as found in aquaponics.

Why use aquaponics?

The idea of growing your own food is making a comeback and is becoming more and more popular across the U.S. much as it has in Australia and the reason is simple. Through modern innovation, it is no longer necessary to "work the land" by plowing, fertilizing, planting, watering and weeding. We now have the technology to grow more healthy organic food, in much less space while using a lot less water.

Imagine being able to grow your own high-quality, 100% organically grown food knowing exactly where it came from. More and more people are beginning to realize the health benefits of eating organic fruits and vegetables while shunning processed foods but organic usually means more expensive unless of course you grow your own. Conventional gardening methods require a lot of work causing many to question—is the healthy choice really worth the extra cost or labor?

Throughout history, it used to be that in order to grow your own food you had to have a farm or garden which meant setting aside some land, tilling the ground and adding fertilizer, planting seeds, watering regularly, pulling weeds and if you are lucky not to have a drought or natural disaster, you reaped a harvest.

I do think most people would really like to live the "organic" lifestyle but if you can't afford the extra cost, growing it yourself conventionally in this day and age, is a bit impractical. Roughly 90% of us have day-jobs and most don't have the time, money, or space to invest into such an endeavor. Farm-work equals hard-work and the benefits of a harvest just isn't enough of an incentive to motivate the common man or woman with so many modern conveniences.

Before the movement of modern convenience beginning in the 1950s when you could start buying processed foods and TV dinners, it was often necessary for many people to hunt and gather or grow their own food for survival. It was not uncommon for a standard family to have several fruit trees, a garden, livestock, pigs and chickens and a system of canning to prepare for the winter season. They knew the value of hard work and reaped the benefits. They did not have the convenience of a local fast-food restaurant where they could buy fried chicken and mashed potatoes or a grocery store where you could buy snack cakes and fish crackers.

Although many people still live self sufficiently, the vast majority of us are caught up in the convenience of instant goods and services delivered anytime, anywhere. Farming, for the most part, has become a lost art and a risky business.

But what if you could reap all the benefits of having a conventional garden including all the healthy fruits and vegetables without the heavy labor and without the risk? It's all possible through the use of aquaponics technology.

The benefits of aquaponics

I. Better Health

Hippocrates - "*Let food be thy medicine* and medicine be thy food"

Modern convenience has brought us tremendous benefits but allowing others to produce our food does have consequences.

In an effort to make food cheaper and more appealing, processes have been introduced into modern mechanical food production.

The following are a few examples of the un-natural additives put in food:

- **Preservatives**—*a type of additive used to help stop food from spoiling*. Natural preservation methods such as the use of salt, fermentation, and food drying have been used by civilizations in the past with great success while modern chemical preservatives such as sodium nitrite, sodium benzoate, and sulfur dioxide are considered by many experts to be harmful and have been shown to cause allergic reactions in some people.

- **Coloring**—*food dyes used to make food more visually appealing.* Natural food coloring is ok but much of our processed foods contain "synthetic" or artificial dyes which have been linked to allergies, asthma and hyperactivity.

- **Sweeteners**—*Chemicals used in food in place of sugar to reduce calories.* Modern examples include Aspartame, Sucralose and Saccharin. These have been linked to allergies, behavioral problems and cancer.

- **Flavorings**—*Chemicals added to food to make it taste like a certain food.* Artificial flavorings have been linked to a variety of adverse reactions while natural flavorings are widely considered safe.

- **Refinement**—*Breaking down food such as flour by separating the starch from the husk.* The problem with refinement is that pure starches are high on the glycemic index. This means that it breaks down quickly into sugar causing blood glucose levels to rise which in turn, increases the risk of obesity.

There is much more but I think you get the idea. Artificial and chemical processes to food is harmful and is linked to allergies, depression, diabetes, toxicity, cancer and obesity. The solution is simple. Consume more organic natural food, and less refined processed food.

What does organic mean?

The U.S. Department of Agriculture (USDA) has established an organic certification program that requires all organic foods to meet strict government standards. These standards regulate how such foods are grown, handled and processed.

Any product labeled as organic must be USDA certified. Only producers who sell less than $5,000 a year in organic foods are exempt from this certification; however, they're still required to follow the USDA's standards for organic foods.

If a food bears a USDA Organic label, it means it's produced and processed according to the USDA standards. The seal is voluntary, but many organic producers use it.

You may see "natural" and other terms such as "all natural," "free-range" or "hormone-free" on food labels. These descriptions must be truthful, but don't confuse them with the term "organic." Only foods that are grown and processed according to USDA organic standards can be labeled organic.

Even if food is cultivated as "organic" it doesn't necessarily mean it's more or less nutritious, but it may be better for you for the following reasons:

- **Pesticides.** Conventional growers use pesticides to protect their crops from molds, insects and diseases. When farmers spray pesticides, this can leave residue on produce. Some people buy organic food to limit their exposure to these residues. According to the USDA, organic produce carries significantly fewer pesticide residues than does conventional produce. However, residues on most products — both organic and nonorganic — don't exceed government safety thresholds.

- **Food additives.** Organic regulations ban or severely restrict the use of food additives, processing aids (substances used during processing, but not added directly to food) and fortifying agents commonly used in nonorganic foods, including preservatives, artificial sweeteners, colorings and flavorings, and monosodium glutamate.

- **Environment.** Some people buy organic food for environmental reasons. Organic farming practices are designed to benefit the environment by reducing pollution and conserving water and soil quality.

There is a downside to buying organic food and is the additional cost due to more expensive farm practices. Because organic foods aren't treated with preservatives they will also spoil naturally.

II. Self Reliance

Stocking your pantry and storing supplies is a great way to prepare for disaster, but 3 to 6 months or even a year of food storage is still (by design) a temporary solution to what could be a much larger challenge when it all comes crashing down.

There are several global crisis scenarios that could adversely affect the masses for many years such as a global economic collapse, world war, solar flares wiping out the electrical grid, asteroid/meteor strikes, earth quakes, famine and other massive earth changes. Any of these examples could cause massive food shortages or inflation making groceries very expensive. Just knowing how to grow food to feed your family without having to use up a lot of land or water would be extremely valuable not to mention life-saving.

III. Save Money

During times of crisis, an aquaponics system would be extremely practical but what about everyday use? Groceries, including fresh fruits and vegetables, are rising in cost every year and economic forecasters are predicting an even sharper incline within the next few years. Some food manufacturers are masking this by selling less product for the same price. For example, processed cheese slices now come in 22 slice packages instead of 24. 3 oz. packages of salmon is now 2.6 oz. and potato chips now come in 14 oz bags instead of 16 oz.

As gas prices rise, so does the cost of growing food by farms across the country. Fuel is required for tilling and fertilizing, applying pesticides, harvesting crops and then delivering the food to market. All that added expense is passed on to the consumer. Growing your own food with aquaponics eliminates these expenses because no fuel was used in production. There is also no need to transport the food except from the grow bed to the kitchen.

These savings put money in your pocket every time you harvest your own fruits, vegetables and fish.

IV. Help the Environment

When there is no fuel used in the production of your food, nothing is burned and there are no emissions spewed out into the air. You can be assured that no pollution was created during the entire process. Although it's not necessary in moderate or tropical climates, even wood used to heat a greenhouse during the winter can be burned in such a way *(with a "rocket mass" heater")* as to eliminate smoke.

With aquaponics, harsh chemicals or pesticides are never used because it is harmful to the fish and will never be released into the environment or the food.

Most farming practices such as raising livestock haven't changed much. Raising chickens and pigs still takes up space and is still hard work but growing your own food doesn't have to be. With the application of simple technologies, one can enjoy the process of food production and the eventual harvest without plowing the field in the hot sun and without the worry of losing crops to drought or disaster.

In the last few years roughly 15% (46 million) Americans are in poverty with 50 million living if food insecure households. There are also about 46.5 million users of the food stamp program at an annual cost of $71,800,000,000. From my point of view, the nation is desperate for a solution.

The home aquaponics system

As an experienced aquaponics enthusiast, before you begin by either purchasing an aquaponics system or building one yourself, I highly recommend that you get familiar with the technology and how it works. I also recommend that you start small and get to know the techniques first hand while you work out the kinks before you spend money on a large system. Mistakes on a small scale are much less costly at this stage while the same mistakes done on a large scale could be catastrophic and very expensive.

Also keep in mind that if you build a DIY system you'll save thousands over purchasing a pre-built kit.

Once you've proven to yourself that aquaponics can work for you on a small scale, you can upgrade to whatever scale you like simply by multiplying the number of systems and increasing the number of grow beds.

I. The Basics

Building an aquaponics system is relatively simple and only requires basic tools such as a drill, saw or pvc pipe cutter, and a utility knife.

The basic home aquaponics system consists of 3 major components. The fish tank, grow bed, and water circulation system.

The fish tank is usually tall such as a stock tank with an opaque surface to block out the sun. Too much sunlight with create algae which is harmful to the fish. Some users are creating systems using water barrels or IBC tanks but they should be painted on the outside to minimize sunlight. I personally prefer to use Rubbermaid stock tanks because of their durability.

The grow bed can be plastic or built out of wood with a plastic liner. Some users again are using water barrels but they tend to be flimsy and need to be propped up on some sort of framework due to the round structure. IBC totes are also used but need the tote's framework to keep it's structure.

The water circulation system consists of a water pump strong enough to circulate water upward to the grow bed where it is then gravity fed back into the tank. There are also valves that are needed to regulate the flow rate into the grow bed/s. The water is constantly being circulated unless it is on a timer so the pump is always on.

Some users build their water pipe system using PVC but I've found that vinyl tubing is very flexible and easy to work with especially when moving components around or adding additional grow beds.

There are additional components that can be added to make it more elaborate such as additional grow tubes/towers and water tanks but the 3 major components are all that is necessary.

The last thing to consider that is needed is a 10' by 10' ft space with a water source and adequate sunlight.

A small $1200 system sold as a kit

II. Maintenance

Maintenance on an aquaponics system requires keeping the tank full and checking the chemical composition of the water. The pH of the water needs to be kept between 6.8

and 7.2 which is very close to neutral. This will allow the plants to absorb necessary nutrients but also allow for nitrification. If the pH is too high, the plants will get sick and die. Also, keeping the plants healthy will naturally ward off insects.

To test your water, you will need a water chemical testing kit which you can purchase and any pet store that sells fish. You will need to test for pH, Nitrites/Nitrates, and ammonia.

These chemicals are regulated by maintaining the nitrogen cycle, the amount of fish you have in your tank, and the number of plants in your grow bed. The pH can be regulated by safely adding acidic or base compounds in small amounts to avoid shocking the fish.

The ratio of plants to fish is very roughly 4 plants to 1 lb. of fish but that depends greatly on how big the fish are, what type of fish and what type of plants you are growing.

The amount of water required in the system is 1 gallon per pound of fish and a ratio of 1/1 for the amount of water in the grow beds to the fish tank.

Types of Aquaponics Systems

I. Countertop Systems

(example of how small an aquaponics system can get.)

This type of system is as small and as simple as it gets. It basically consists of a fish tank which can be as simple as a fishbowl or a standard aquarium style tank. The same care taken with an aquarium must also be observed in an

aquaponics system. The fish still require oxygenated air, fish food, and a stable An environment where pH and water temperatures can remain the same. Plants can be placed right above the tank where the roots can hang in the water, usually in small pots with grow media (not soil) inside.

Although plants need adequate sunlight, avoid placing your tank directly in the sun where the water temperatures can fluctuate throughout the day. Drastic changes to the water temperature can shock the fish causing stress, sickness and death.

II. Indoor Systems

Indoor systems can be large scale countertop systems or smaller outdoor systems adapted for indoor use. The advantage of having an indoor system is climate control and year round plant growth. It also eliminates the need for pest control however in a perfect environment pollination can be difficult for fruit bearing plants. Indoor decorative plants can do well in an aquaponics system and brighten any space.

Some other issues with indoor systems is making sure the plants get enough light and the style of maintenance required for outdoor systems. Bringing a hose inside to fill the tank can be a messy chore and the pump noise could become annoying depending on the size.

Many people have created indoor hydroponic systems using artificial lighting and timers for the flood and drain systems. These technologies and techniques can be adapted for aquaponics as well.

Indoor aquaponics Japanese style.

III. Backyard Systems

Backyard systems are the most popular type for those wanting home food production. Those already experienced with gardening will find the transition to aquaponics a very easy process.

These systems can be placed in the fenced-in corner of the backyard, on a balcony, deck or up against the house. Wherever you choose to put your system it is a good idea to place it near a water spigot for easy water changes and general maintenance such as cleaning filters and such.

Backyard systems offer the ability to "upgrade" and add components for increased food output. There's also more room to experiment as those who have mastered aquaponics often do.

A simple backyard system designed for home food production.
Learn how to build a system just like this at www.easydiyaquaponics.com.

About Fish

One of the most often questions I'm asked is "where can I get fish?"
In my experience the best people to ask are local pet store owners. Most of them are already familiar with local sources of just about any type of fish you would be looking for.

If you are just starting out I recommend getting "feeder" fish or goldfish. They are usually very cheap between $.10 to $.15 per fish. Goldfish are very resilient and less costly to lose.

Once you know how to run a system successfully you can move up to edible fish such as tilapia for warm climates, or trout and catfish for moderate climates. You can also contact your local fish hatchery to get more info on purchasing fish for home use.

About Plants

Just about every plant grown in a backyard garden can work in an aquaponics system. Just keep in mind that leafy green vegetables can grow well with the roots always in the water while most other plants require oxygen at the root level. That's why flood and drain systems work so well. Root plants such as carrots, onions and radishes require a deeper growbed.

If you are just starting out I recommend trying leafy greens first such as lettuce and herbs first because they are the easiest to grow using this method. After you've become familiar with aquaponics you can move into the standard variety of vegetables such as tomatoes and beans and then move up to root plants from there.

I've been asked about potatoes which require a dryer climate. Although I'm sure someone out there has found success in growing potatoes in an aquaponics system, I recommend growing them in soil.

About the Author

I've been doing aquaponics for about 3 years now and I remember how overwhelming it was for me starting out. I also know how frustrating it can be just knowing where to begin. There is so much information on the internet about aquaponics, (much of which is very complicated) that it's easy to get information overload. I've learned through the years though that aquaponics is actually easy and just about anyone can do it with the RIGHT instructions.

My mission is to help people learn and understand what aquaponics is all about and what it can do to change lives and our planet. It is a proven method for organic food production that anyone can do at home. It can be as simple as a hobby, a way to supplement a grocery budget or it can become a full blown organic food farm business.

If you have any questions about starting or maintaining your system I would love to answer them! Feel free to contact me at the website and email address below.

Cheers!

Andrew

P.S. Learn how to create your own aquaponics system at home the easy way by doing it yourself. Save thousands compared to online systems with "DIY Aquaponics".