



Is Aquaponics for You?

Realities and Potentials for Arkansas

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Aquaponics is becoming a popular way to grow your own plants and fish in a chemically safe and relatively sustainable manner. It combines aquaculture systems used for growing fish with hydroponic cultivation of plants.

For all practical purposes, hydroponics is a type of soilless gardening that involves growing plants in water supplemented with nutrients. This enables plants to freely absorb required nutrient ions from the water contained within a given system. Nutrient concentrations in the water must be measured and maintained at specific levels based on the types of plants being grown. Although water must be added to the system to account for evaporation and transpiration, it is estimated that hydroponic gardening utilizes one-tenth the amount of water used in traditional terrestrial gardening. There are numerous advantages and disadvantages of hydroponics over traditional soil-based gardening.

Advantages of Hydroponics

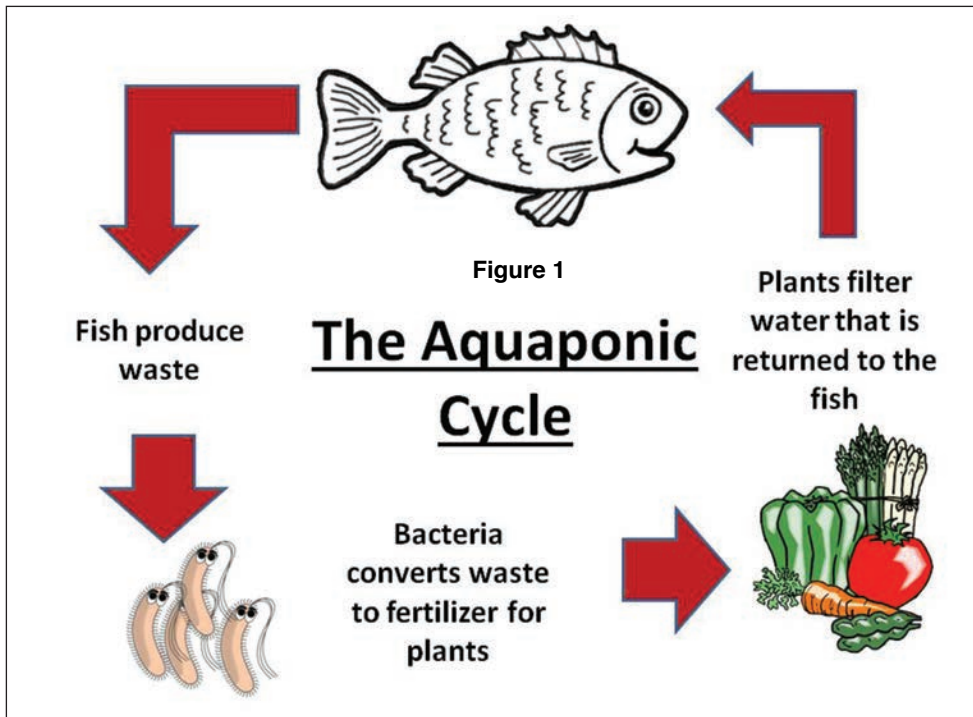
- Lower water requirement
- Controlled system
- Avoid most soil-borne diseases

- Easy harvesting (no need to bend over)
- Easier pest control due to elevated growbeds
- Higher yields
- Stable crop yields in small systems
- Less climate restrictions
- Proven technology with numerous commercially viable hydroponic systems

Disadvantages of Hydroponics

- Expensive nutrient solutions
- Nutrients more difficult to keep in balance
- Salt accumulation
- Installation costs
- Technical skill required to cope with soilless culture systems

Aquaponics provides the same benefits for plant production as hydroponics but comes with the increased complexity of managing both fish and plants integrated into one system as well as the bacteria that converts fish wastes into fertilizer (Figure 1). However, instead of having to constantly add and measure plant nutrients as with hydroponics, plant nutrients come predominantly



dechlorinate the water before stocking fish and any time water is added to the system. Chlorine used in municipal water will kill your fish.

- What can be done if the fish get sick? It is imperative that the disease be diagnosed and treated. Unfortunately, most treatments for fish diseases are not safe for plants. You will need to have a separate treatment tank or a method to make sure the plants are not exposed to the treatment required by the fish.

from the fish production tank. In appropriately designed aquaponic systems, fish provide adequate nutrients for the plants.

Things to Consider When Caring for Fish

Caring for fish in an aquaponic system adds considerable complexity to an indoor gardening system. The following are key questions that should be considered carefully before investing in an aquaponic system:

- Do you have the time to care for fish? Fish need to be fed every day, so if you plan on going out of town for a week, you will need someone to feed and maintain fish while you are gone.
- What will you do if you lose power? Fish require good water quality which includes adequate oxygen levels and minimal nitrogen levels. If you are not around and the power goes out, you risk losing fish due to lack of oxygen from aeration and filtration. Even if fish do not die during a power outage, they may become more stressed, which can lead to disease outbreaks.
- What is your water source? Use only well water, uncontaminated rain water or treated municipal water. If municipal water is used, you will need to

Three Types of Aquaponic Systems

There are three main types of aquaponic systems with different advantages and disadvantages (Table 1). Some types are more suitable for backyard or small-scale systems while others work best for large commercial hydroponic systems.

Floating Raft (Deep Water Culture) Systems

The floating raft system (Figure 2) involves growing plants supported by polystyrene (or similar) rafts that float on top of a relatively deep (12-24 inch) water trough. The plants are supported by the rafts



Figure 2. Floating Raft System

while their roots are directly submerged in the nutrient-rich water below. Floating raft systems are generally used in commercial aquaponics for production of herbs and leafy greens.

NFT Systems

The nutrient film technique (NFT) (Figure 3) involves a trickling or low flow of nutrient-rich water down an inclined pipe or gutter. The plant roots hang down and draw up nutrients as needed from the film of water while still allowing for a portion of the roots to be aerated. NFT systems are commonly used in

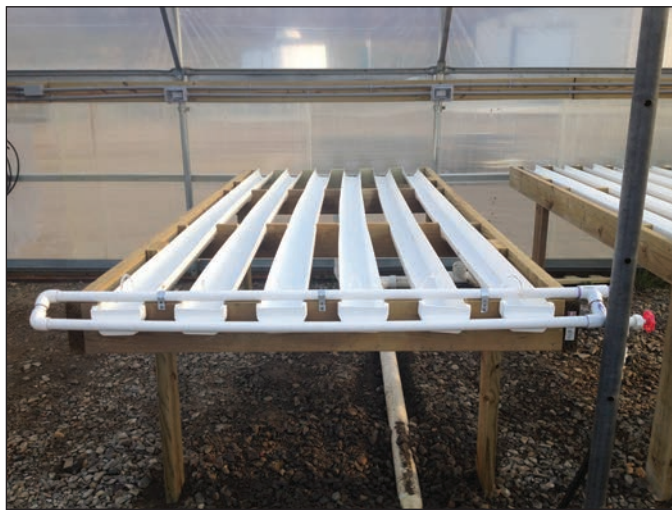


Figure 3. NFT System

commercial systems for production of herbs and leafy greens, although individuals have utilized this design to maximize space at home.

Flood and Drain Systems

Flood and drain systems (Figure 4) involve growing plants in a media-filled growbed that regularly fills and drains with nutrient-rich water. The ebb and flow of water in the growbed allows for root aeration and helps prevent anaerobic conditions that might otherwise occur. The flood and drain system is used frequently for home-based aquaponics.

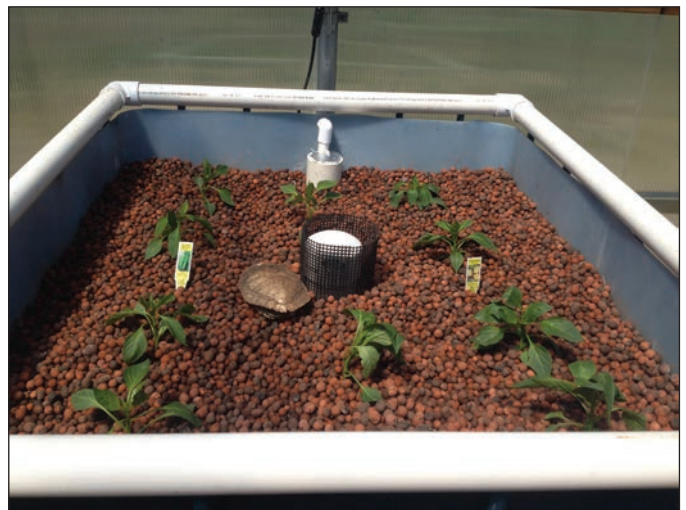


Figure 4. Flood and Drain System

Table 1. Choosing the Right System

System Type	Pros	Cons
Floating Raft (Deep-Water Culture)	<ul style="list-style-type: none"> – Easy plant rotation – Great for lettuce and herbs – Can withstand power outages – Most resistant to temperature and pH fluctuations 	<ul style="list-style-type: none"> – Limited to herbs and leafy greens – More aeration needed – Need separate biofilter
NFT System	<ul style="list-style-type: none"> – Great for herbs and leafy greens – Can utilize limited space – Allows for root aeration – Fish and plants can be decoupled 	<ul style="list-style-type: none"> – Plants will die quickly if pump clogs or stops functioning – Need separate biofilter and solids removal – Water temperature fluctuations
Flood and Drain (Ebb and Flow)	<ul style="list-style-type: none"> – Can grow almost anything – Growing media acts as biofilter and mechanical filter – Allows for most intense plant spacing – Simple design 	<ul style="list-style-type: none"> – Bell siphon required (can be tricky) – Media can be expensive – Pump more likely to clog (in fish tank)

Growing Strategies

The climate in Arkansas ranges from hot and humid in the summer to cold and snowy in the winter. The typical growing season for most fish and plants ranges from April to October but will do best with increased sunlight and temperatures above 65°F. Before investing in aquaponics, you will need to decide on a growing strategy.

- Grow indoors – Can grow crops year round, will need UV grow lights. Important to consider water spillage if you are choosing this option.
- Grow outdoors – Generally you can grow crops from May to September, so will have to either shut down in the winter or bring the system indoors. This is the most common strategy for small-scale aquaponics and likely the lowest cost as you do not need to purchase grow lights or a greenhouse if you plan on shutting down in the winter.
- Grow in a greenhouse – Without heating the greenhouse, the growing season is from March until December. With some heat, plants and fish may be able to survive through the winter but will not grow as quickly without additional light. Without additional heat or light, how much slower they grow depends on the plants and fish species in the system as well.

Backyard Aquaponics

Size of your system is another important consideration when setting up an aquaponic system. The larger the system, the more time and effort it will require to maintain.

Small-scale or backyard aquaponics is a great way to produce your own food and also serves as a useful learning tool for schools and communities. Investments can range from \$100 if you are using a 10-gallon aquarium to grow herbs to well over \$50,000 if you buy a greenhouse, depending on the size of the system and the materials used to build it. Typically you can save over 50 percent of the cost if you build it yourself.

While having an additional crop with fish can seem like a good idea, this isn't always enough to offset the large cost associated with adding the aquaculture component. Tanks, plumbing and fish feed are all large costs, plus there is added risk created by the fish. The fish themselves will require additional care, so hydroponics may be a better alternative for individuals who do not have time every day to feed and care for their fish.

Harvesting

Fish and plants need to be harvested from your system to maintain balance. Some plants can overgrow your system and so need to be continuously pruned and harvested. Some leafy greens grow bitter if left in your system too long, while fruits can go bad if left to overripen. Techniques and strategies from traditional gardening should be applied where necessary. Edible fish should be harvested once they reach market size and replaced as needed.

Food Safety

Food safety is another important concern for aquaponic gardens. Food-borne illnesses are a major issue, so it is important to take steps to reduce possible contamination of your produce. Proper hygiene should be practiced, and hands should be washed prior to touching any plants. Any time produce is harvested, latex, rubber or nitrile gloves should be worn, and every effort should be made to avoid contact between the produce and the growing media. Storage facilities and containers should be kept clean and surfaces that will come in contact with produce should be sterile.

Other Considerations

- Do you have adequate space available for use, and at what cost?
- Do you have a well? Well water generally has higher alkalinity than municipal water which helps stabilize the pH of your system. This can be a potential benefit to you and your plants.

Choosing Fish

You will need to obtain an Arkansas fish farmer permit from the Arkansas Game and Fish Commission (AGFC) if you plan to sell your fish.

It is a good idea to make sure the fish you plan to grow is on the Approved Aquaculture Species List or you will need to apply for a restricted species possession permit or unlisted aquaculture species permit from AGFC.

Table 2. Best Choice Fish (Easiest to Care for and Manage)

	Why Choose?	Considerations
Goldfish (or Koi)	Hardy fish with many sizes and colors available. They also do not require an expensive feed.	Will eat plant roots if culturing in same tank as plants.
Golden Shiners	Readily available in Arkansas and perfect for maintaining supply of baitfish if you are an avid fisherman. Great for stocking small systems and will consume cheap commercial feeds readily.	Not edible.
Fathead Minnows		
Hybrid Bluegill	Commercially available in Arkansas and grow very well in tanks. Tasty and hardy pan fish that will accept cheap commercial feeds and grow big enough to warrant eating.	Best when stocked at high numbers to avoid aggression. Also must be fed regularly.
Tilapia	Tasty and hardy fish that will filter feed as well as consume cheap commercial feeds.	Cold intolerant (will not survive winters without tank being heated). Will readily reproduce in tanks even before growing to edible size.

Table 3. Other Fish Options (Require More Care and Management)

	Why Choose?	Considerations
Rainbow Trout	Tasty fish; will readily accept commercial feeds; grow rapidly.	Require cooler water (winter option); high protein feed required (more expensive); higher oxygen levels required; only available seasonally.
Largemouth Bass	Tasty fish; commercially available in Arkansas.	Do better when crowded; high protein feed required (more expensive); produce larger solid wastes.
Hybrid Striped Bass	Tasty fish; commercially available in Arkansas.	High protein feed required (more expensive); more sensitive to changes in temperature and water quality.
Crawfish	Tasty; can be used for bait; commercially available in Arkansas.	Can reproduce in tanks which will allow them to invade the entire system; territorial.*
Freshwater Shrimp	Tasty.	Territorial*; expensive; cold intolerant (below 65°F); poor availability.

*Territorial animals exhibit cannibalism.

Selecting Which Crops to Grow

Many crops that grow well in Arkansas can likely be grown in an aquaponic system. Your options change if you are using a greenhouse or indoor system. Some plants grow faster than others, while some plants require more work and maintenance than others. Also, some plants are available as transplants while others are available only as seeds. If you do not want to bother with seeds, then your options will be more limited, but success will be visible sooner. Plants should be chosen based on individual preferences and the system being used. It is important to keep in mind that an ebb and flow aquaponic system provides the most options. A plant hardiness map for Arkansas is shown in Figure 5.

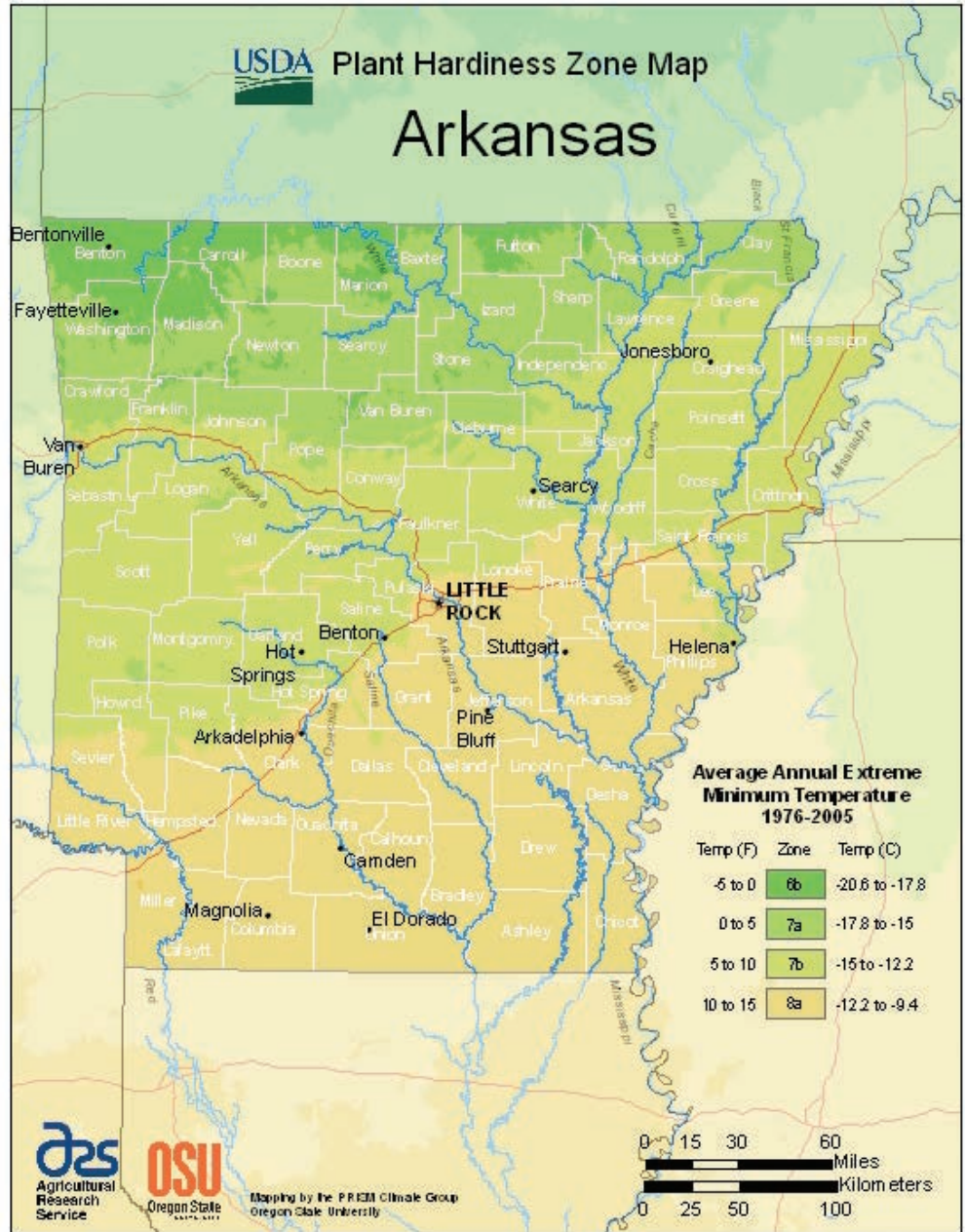


Figure 5.
Plant Hardiness Zone Map
for Arkansas

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