Alternative Ag Ventures - Aquaponics

Photo by: The Center for Innovative Food Technology on location at Rainfresh Harvests (www.rainfreshharvests.com)

Aquaponics is defined as the symbiotic cultivation of plants and aquatic animals in a recirculating environment. Fish waste accumulates in water as a by-product of keeping them in a closed system or tank. The water becomes high in plant nutrients and plants are grown in a way that enables them to utilize the nutrient-rich water. The plants uptake the nutrients, reducing or eliminating the water's toxicity for the aquatic animal.

- Taken from Wikipedia, The Free Encyclopedia; www.en.wikipedia.org, search Aquaponics

Introduction

Aquaponics is basically a combination of hydroponics and aquaculture. With aquaponics, you are growing fish and plants (usually vegetables and herbs) in an integrated recirculating system, together. The waste from the fish provides nutrients to feed the growing plants, while the plants act as a natural water filter for the water that the fish live in. This results in a sustainable ecosystem that allows both plants and fish to thrive.

Hydroponics involves growing plants without soil. Water and nutrients create a solution that is fed directly to the plants' roots. Most hydroponic systems involve a growing medium where the plant roots are kept moist and help support the plant. In hydroponics the plant is provided optimum growth conditions with ideal water and nutrient ratios for growth.

In aquaculture, fish are grown in enclosed tanks or ponds that can quickly become rich in nutrients due to fish waste from digestion. If in enclosed tanks, the waste water is filtered to keep the tank water free of toxic buildups.

In aquaponics, the fish waste provides a food source for the growing plants and the plants provide a natural filter for the fish. This creates a mini ecosystem where both plants and fish can thrive. Aquaponics is the ideal answer to a fish farmers problem of disposing of nutrient rich water and a hydroponic growers need for nutrient rich water.

Market Information

When considering the market for the products from an aquaponics operation there are two separate categories; fish and plants, most likely leafy vegetables and/or herbs since these are best suited for aquaponics.

For the fish in an aquaponic operation there are two basic market segments, depending on which species are incorporated; the first is food. Edible fish species that do well in aquaponic operations include crappie, blue gill, tilapia, trout, perch, Arctic char, and bass. However, tilapia is the primary species used for recirculating aquaponic systems in North America due to its hardiness and ability to tolerate a wide variety of conditions.

The second outlet for aquaponic fish could be the ornamental market. Ornamental markets include tropical and cool water fish for aquarium and landscape ponds. A majority of the Midwest ornamentals include sales of goldfish, and Koi Carp.

Markets for the plant products could include a variety of outlets such as direct on farm or farmers markets, local restaurants, local retailers, natural or organic food stores.

Hydroponic produce growers are located worldwide. Of over 50,000 acres in hydroponic production around the world, approximately 1,200 of those are US acres. Most of these facilities in the US are small family-owned businesses that produce on 1/8 - 1 acre. These farms produce high-quality produce and sell it locally. Smaller operations have an advantage of offering locally-grown produce with minimal transportation cost and damage. It is possible for a hydroponic grower to yield an excellent profit in this niche marketplace, offering premium local produce on less than an acre of land. Smaller growers can establish themselves near the marketplace, eliminating the problems and costs of long-distance transportation.

In addition to the smaller growers in the US, there are several large hydroponic facilities that cover as many as 60 or more acres and produce large quantities of hydroponic tomatoes, peppers, cucumbers and lettuce. (Aquaponics.com)

Production Considerations

Hydroponics:
It is important, when looking into an aquaponic system, that you become educated and familiar with hydroponic growing practices and systems. There are two basic systems in use for hydroponic produce today; liquid hydroponic systems, and aggregate systems. Liquid systems have no other supporting mediums for plant roots, while aggregate uses a solid medium of some kind for root support (sand, gravel, perlite, etc.) These systems are further categorized as being either open or closed. Open meaning that once the nutrient solution is delivered to the plants it is not reused, and closed being the practice of recovering, replenishing, and recycling the solution.

Nutrients in Fish Waste:
Because nutrients to the plants in an aquaponic system are delivered via fish waste, growers do not have as much control over the precise mineral element quantities as in a normal hydroponic operation. However fish waste does contain sufficient amounts of ammonia, nitrate, nitrite, phosphorus, potassium, and other micronutrients necessary for hydroponic plants. Some plant species are better adapted to this practice than others so it is important to choose wisely.

Plants Best Suited for Aquaponics:
Plant selection is directly related to the amount or density of fish utilized in an aquaponic system. The denser the fish, the more waste, which equals higher concentrations of nutrients to grow crops. Greens such as spinach, lettuces, herbs, chives, and watercress have low to medium nutritional requirements and are well adapted to growing in aquaponic systems.

Plants that yield fruit, such as tomatoes, or cucumbers have more nutritional requirements to produce the fruiting bodies on the plant and perform better in a heavily stocked (fish) system. Also, greenhouse varieties are better suited to high humidity and low light conditions compared to field varieties.

Fish Species:
As mentioned above the most common species in an aquaponic system include crappie, blue gill, tilapia, trout, perch, Arctic char, and bass in the food grade category and ornamentals like goldfish, and Koi Carp.

Water Quality:
Recirculating water systems used for aquaculture and or aquaponics must be managed properly to insure good quality water conditions. While the aquaponic system is relatively self sufficient for filters and nutrients, it is still important to test the water via water quality testing kits. Kits are available from aquaculture supply companies. Special attention must be given to dissolved oxygen, carbon dioxide, ammonia, nitrates, nitrites, pH, and chlorine levels to ensure a proper balance. The density of the fish, rate they are feeding, and environmental changes or fluctuations can effect water quality, causing things to change quickly.

Biofiltration:
This is the process of incorporating intermediate filters to collect suspended solids from fish waste, thus allowing for facilitation of ammonia and other waste conversion to forms more available to plants. Biofiltration could be a system of cartridges or utilizing a gravel-cultured hydroponic vegetable bed to deliver nutrient conversions. The bed system removes dissolved solids and provides the nitrifying bacteria a habitat for nutrient conversions.

Component Ratios:
It is important to maintain the proper component ratio in an aquaponic system. This is the amount of fish tank water to volume of hydroponic media. A 1:2 ratio, respectively, is most common, but tank: bed ratios as high as 1:4 are being utilized. This variation of ratio depends greatly on a number of factors including, type of hydroponic system, fish species and density, plant species, feeding rate, etc.

Number of Fish:
The number of fish that you put in your tanks directly depends on the size of tank and type of filtration system. A simple aquarium based system does well with 1-inch of fish length per gallon of water and commercial operations usually stock tanks to 1/2 pound of fish per gallon, maximum.

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Economics

Aquaponics, like any business venture takes a significant amount of investment in equipment, the right system design, management and marketing skills.

Nelson and Pade, Inc. offers aquaponic (organic hydroponic) systems for all applications including: hobby, home food production, education, commercial and research. CropKing, Inc. also sells a hobby, educational, or home production system as well. These systems range in cost from $2,300 to over $45,000 without the greenhouse structures. With greenhouse structures you are looking at $6,300 to nearly $79,000.

The Nelson and Pade systems report having generated anywhere from 864-57,600 heads of lettuce from a single system per year depending on the size.

Current market prices in March 2008 when this report was written indicated hydroponic lettuce prices at $1.25-1.38 per head. Thus resulting in gross annual sales at $1,080 to $72,000.

Other commodities typically grown in hydroponic or aquaponic systems reported the following market trends:
Tomatoes - $1.06-1.10/lb.
Peppers - $1.09-1.64/lb.
Cucumbers - $1.20/lb.
Seedless - $7-8.50/12ct.
Eggplant (med.)- $2.36/lb.
(lge.) - $1.27/lb.

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