COURSE

Introduction to Aquaponics

MODULE 02

Fish Selection & Care

This material is based upon work supported by the National Institute of Food and Agriculture, U.S. Department of Agriculture, through the Northeast Sustainable Agriculture Research and Education program under sub award number *ENE25-189*.

NORTHEAST SARE Sustainable Agriculture Research & Education

BY

Oko Farms

Today's Agenda

- ➔ **Types of Fish For An Aquaponics System**
- ➔ Feeding Fish
- ➔ Fish Density
- ➔ Tank Selection
- ➔ Daily Care and Management
- ➔ Fish Welfare
- ➔ Reading and Resources

Fish are the engine of an aquaponics system.

- They are the nutrient generators for plant production as well as a potential food source, depending on the type of fish that is cultivated.
- There's a wide variety of freshwater fish used in aquaponics including koi, hybrid striped bass, barramundi, goldfish, yellow perch, trout, tilapia, sunfish, crappie, pacu, carp, and freshwater prawns, angel fish, swordfish, mollies, tetras, guppies and bream.
- They are generally divided into finfish and shellfish.

Recommended Fish For Aquaponics

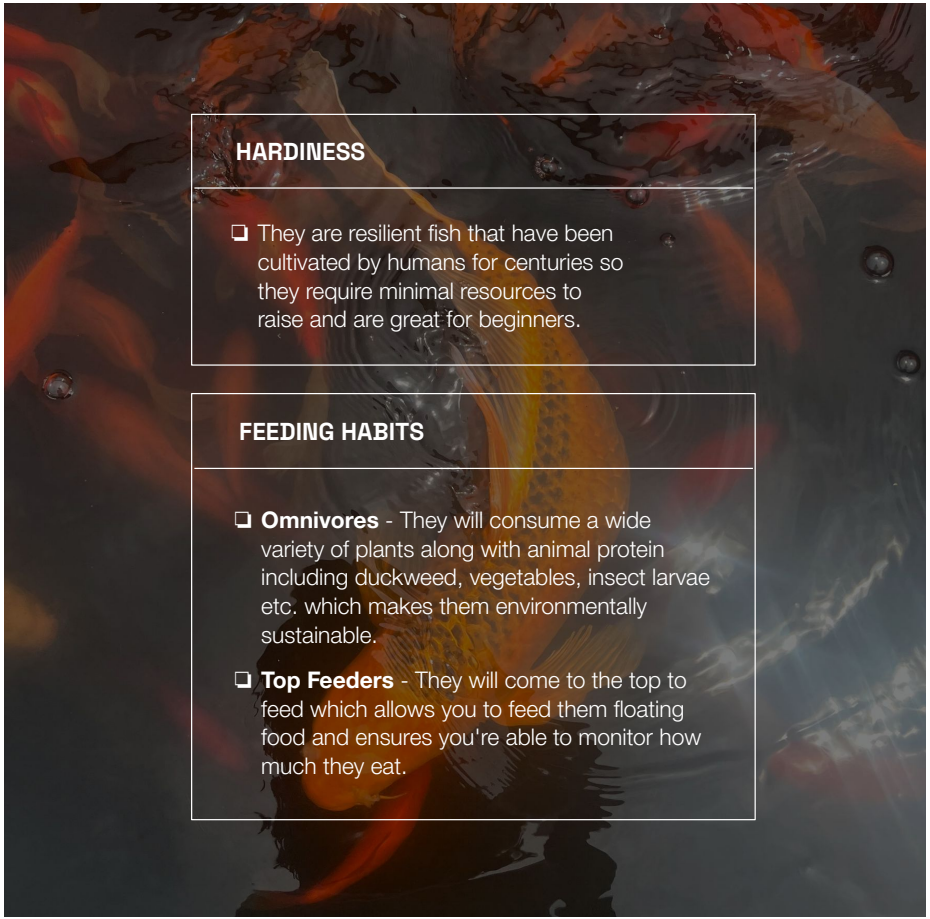
CARP
Goldfish, Koi, Common Carp, Mirror Carp, etc.

TILAPIA

BLUE GILL

FRESHWATER PRAWNS

CRAWFISH



HARDINESS

- They are resilient fish that have been cultivated by humans for centuries so they require minimal resources to raise and are great for beginners.

FEEDING HABITS

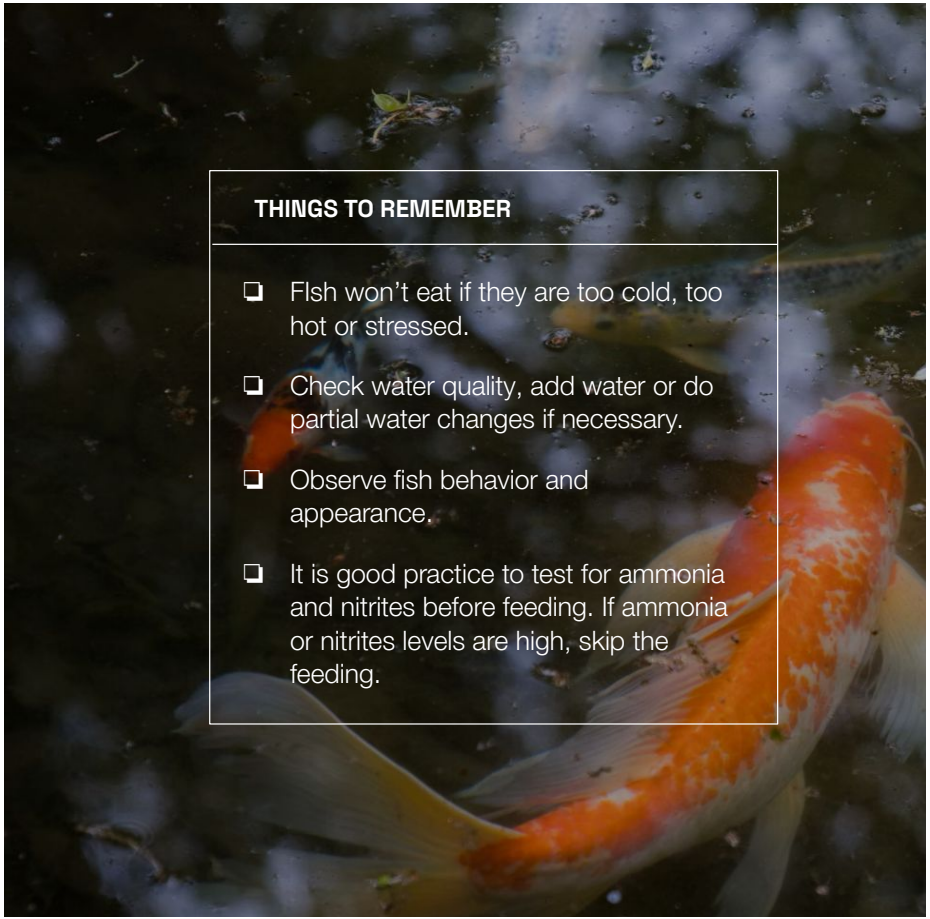
- **Omnivores** - They will consume a wide variety of plants along with animal protein including duckweed, vegetables, insect larvae etc. which makes them environmentally sustainable.
- **Top Feeders** - They will come to the top to feed which allows you to feed them floating food and ensures you're able to monitor how much they eat.

Fish Comparison Chart

	TILAPIA	TROUT	HYBRID STRIPED BASS	CARP
TEMP RANGE	70-85	38-68	44-75	32-80
OPTIMAL RANGE	75-80	55-65	65-70	65-75
CARNIVORE/OMNIVORE	OMNIVORE	CARNIVORE	OMNIVORE	OMNIVORE
HARVEST SIZE	1.5 LBS	1.5LBS	1-2 LBS	1-2 LBS
TIME TO MATURITY	7-9 MONTHS	12 MONTHS	18-24 MONTHS	N/A
OXYGEN REQUIREMENT	LOW	HIGH	LOW	LOW
TOP/BOTTOM FEED	TOP	TOP	TOP	BOTH

Feeding Fish

- ❏ Feed your fish 2-3 times per day; only what they can eat within 5 minutes.
- ❏ Remove any leftover food immediately.
- ❏ Fish eat approx. 1.5-2% their body weight per day.
- ❏ Observe your fish when eating to help determine the proper amount of feed.



THINGS TO REMEMBER

- ❏ FIsh won't eat if they are too cold, too hot or stressed.
- ❏ Check water quality, add water or do partial water changes if necessary.
- ❏ Observe fish behavior and appearance.
- ❏ It is good practice to test for ammonia and nitrites before feeding. If ammonia or nitrites levels are high, skip the feeding.

Food Choices for Omnivorous Fish

- ❏ Commercial pelleted Feed
- ❏ Duckweed
- ❏ Algae
- ❏ Worms
- ❏ Insect Larvae
- ❏ Vegetable Scraps
- ❏ Small fish and shrimp

FISH FEED

- ❏ Fish have specific dietary needs based on their species, size, and maturity.
- ❏ The size of the food given must be relative to the size of the fish's mouth.

COMMERCIAL PELLETED FISH FEED

- ❏ Commercial fish feeds contain exact protein, carbohydrate and other vitamin requirements for specific fish.
- ❏ Plant based proteins can include soy meal, corn meal, wheat meal etc.
- ❏ Most commercial feeds are between 10% to 50% protein.

Food Choices for Omnivorous Fish

TILAPIA POWERSTART FRY POWDER

premiumfishfood.com

- Size: Powder
- A fine powder used for newly hatched fry for the first 3 weeks of growth. The high protein and fat content in this powder gives your fry a head start on fast growth. Often times, fry are virtually starved for their first several weeks of life and become stunted because they are unable to consume the larger sized food often offered to them. Starting fry off right is important because it has a great deal of influence on how fast they will grow as fingerlings and adults. PowerStart can drastically improve growth rates, substantially reducing days until harvest.

GUARANTEED ANALYSIS

Crude Protein (min) 50.00%
Crude Fat (min) 17.00%
Crude Fiber (max) 3.00%
Phosphorus (min) 1.5%

INGREDIENTS

Fish meal, wheat flour, fish oil, brewers dried yeast, vitamin mix.

Food Choices for Omnivorous Fish

ZEIGLER KOI GROWER

koimarket.com

- ❏ Koi Grower Koi Growth food from Zeigler is a top performing growth food for your pond fish and will provide big growth results in your koi.
- ❏ Contains natural marine ingredients including spirulina, vitamin C and brewers yeast. High levels of marine protein aid in maximizing growth and digestion.

INGREDIENTS

Wheat, Fish Meal, Corn Gluten Meal, Dehulled Soybean Meal, Hydrolyzed Feather Meal, Dehydrated Alfalfa Meal, Brewers Dried Yeast, Monosodium Phosphate, Fish Oil, Soy Lecithin, Spirulina, Salt, Shrimp Meal, Choline Chloride, Vitamin A Acetate, Vitamin D3 Supplement, dl-Alpha Tocopheryl Acetate (Vitamin E Supplement), Vitamin B12 Supplement, Niacin, Calcium Pantothenate, Menadione Sodium Bisulfite Complex (source of Vitamin K Activity), Folic Acid, Thiamine Mononitrate, Pyridoxine Hydrochloride, Biotin, Manganese Proteinate, Zinc Proteinate, Copper Proteinate, Calcium Iodate, Iron Proteinate, Cobalt Proteinate, Calcium Carbonate, Sodium Selenite, L-Ascorbyl-2-Polyphosphate (source of Vitamin C), Canthaxanthin, Yeast Extract, Artificial Color.

Supplemental or alternative feed should also be considered.

Alternative feeds should be considered like duckweed, insects or black soldier fly larvae.

Duckweed:

- ❏ Duckweed grow quickly and produce new offshoots rapidly.
- ❏ Dense populations are an important food source for aquatic waterfowl and fish.
- ❏ These plants grow floating in still or slow-moving fresh water.
- ❏ **Nutritional Composition:** 20-35% protein, 4-7% fat, 4-10% starch per dry weight.

Fish Density

- The simplest stocking density is to allow 1-5 gallons of water per fish depending on the oxygen requirements of your fish.
- Tilapia, koi, and goldfish can tolerate a 2:1 water to fish ratio while other fish like trout, perch, and bass require higher water to fish ratio.
- Adding and oxygen pump to your system allows you to increase your stocking density, however, you risk losing your fish if your pump breaks unexpectedly.

Tank Selection

- ❑ No less than 5 gallons of water per fish.
- ❑ Make it dark.
- ❑ If possible, ensure it has corners.
- ❑ Give them room to swim.
- ❑ Make room for autonomy (add some hiding spaces).
- ❑ Better yet, stimulate their minds; give them something to play with.

Daily Management & Care

- ❑ Check water quality daily.
- ❑ Do not feed fish if ammonia or nitrite levels are high.
- ❑ Feed fish 2-3 times per day for no more than 5 minutes at a time.
- ❑ Ensure the fish tank is properly aerated. Fish need oxygenated water to survive.
- ❑ Do not put anything in the water that is not safe for fish including fertilizer, pesticide etc.
- ❑ Make sure harvested plants are replaced immediately.
- ❑ Treat infected fish with a mild salt water solution.

Fish Welfare

Our understanding of the inner lives of aquatic animals is growing rapidly: fish are intelligent, emotional, and far more complex than we ever realized.

Exploring the underwater world, we have discovered fascinating behaviors that stem from the same foundations as ours: a brain that can detect pain, process emotions and learn from mistakes, and a drive to survive.

When fish are kept in poor living conditions, they can become ‘pessimistic’. They become uninterested in food, stop interacting with each other and become vulnerable to diseases and/or infections.

THINGS TO REMEMBER

- **A Stable Environment:** Constantly changing water disturbs the fish– water has its own stable microbiome after cultivating a farm for years or decades– keeps fish healthier
- **Density:** High fish density can also increase rates of disease transmission– additionally, while fish may survive at higher densities that does not mean their quality of life is good.
- **Fear:** Learning to avoid danger is one important reason that animals feel fear. Fish definitely feel fear and react accordingly.They show fear by swimming away and hiding in corners.
- **Pleasure:** Fish have the hormone oxytocin (or its equivalent, isotocin), which is associated with pleasure in humans and other animals. When fish are happy, they interact with each other, swim about rapidly and respond swim toward humans. Giving fish objects to play with and investigate increases their mental and emotional health. Feeding them on a schedule is also beneficial to their mental and emotional health.

References & Resources

PURCHASING & INFO (FISH)	FISH FOOD
Live Aquaponics	Premium Fish Food
Backyardtilapia.com	Black Soldier Fly Larvae
Aquaculture of Texas (freshwater prawns)	
SUNY Cobbleskill	

COURSE

Introduction to Aquaponics

MODULE 02 SUPPLEMENT

Fish Selection Guide

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Selecting appropriate fish species for an aquaponics system is essential to maintaining a healthy and productive ecosystem.

This guide was developed to assist readers in choosing fish that align with their experience level, climate, budget, hardiness and production goals. Our farm team has successfully raised all of the fish species included in this guide, with the exception of trout. Trout are not well suited to our outdoor farm in New York City, as we are unable to sufficiently cool the water during the summer months.

THINGS TO CONSIDER

- **SOURCING FINGERLINGS:** Whether raising fish for personal consumption or for sale, it is essential to choose species that can be sourced reliably and consistently. We recommend researching local fish hatcheries or nearby aquarium suppliers to ensure convenient and dependable access to fingerlings.
- **CLIMATE:** Unless you are growing indoors with the ability to precisely control water temperature, your local climate will largely determine which fish species are most suitable for your system. Even indoor growers face the risk of significant fish losses if they are temporarily unable to maintain adequate heating or cooling for the fish.
- **ALTERNATIVE OPTIONS:** Aquaponics systems are not limited to finfish species. This guide includes freshwater prawns which can be successfully integrated into aquaponics systems. Crustaceans are effective alternatives or complementary additions to finfish, contributing to system diversity and offering additional production opportunities.
- **TANK SIZE:** For fish welfare purposes, we recommend that fish tanks be at least 2 ft deep and 2 ft wide to allow fish adequate room to swim.

FISH OPTIONS

- ➔ GOLDFISH
- ➔ KOI
- ➔ CARP (COMMON. MIRROR + GRASS)
- ➔ TROUT
- ➔ TILAPIA
- ➔ CHANNEL CATFISH
- ➔ BLUE GILL
- ➔ FRESHWATER PRAWN

ORNAMENTAL CARP

GOLDFISH

Benefits

- ❏ Thrives in a wide temperature range
- ❏ Hardy and great for beginners
- ❏ Produces high ammonia which is great for plant growth
- ❏ Easy to source
- ❏ Sells at a high price compared to edible fish
- ❏ Tolerant of minor temperature and pH swings

GOLDFISH

Additional Characteristics

Temperature Range	Thrives best in water temperatures of 68° to 74°, but can survive as low as 32 °and high as 80°
Maximum Length and Weight	14 inches, 4.4 pounds
Life span	15 years
Stocking density	Minimum of 2 gallons of water per fish
Tank	Minimum 120 gallons; no less than 2’ deep and 2’ wide
Diet	Needs a diet with approximately between 20% and 35% protein, can eat different types of small insects, small aquatic life, duckweed, algae and commercial fish food
Top or bottom feed	Both
Dissolved Oxygen	Requires adequate oxygen (5+ ppm)

ORNAMENTAL CARP

KOI

Benefits

- ❏ Wide temperature range
- ❏ Hardy and great for beginners
- ❏ Tolerant of minor temperature and pH swings
- ❏ Omnivorous diet
- ❏ Easy to source
- ❏ Sells at a high price compared to other fish

KOI

Additional Characteristics

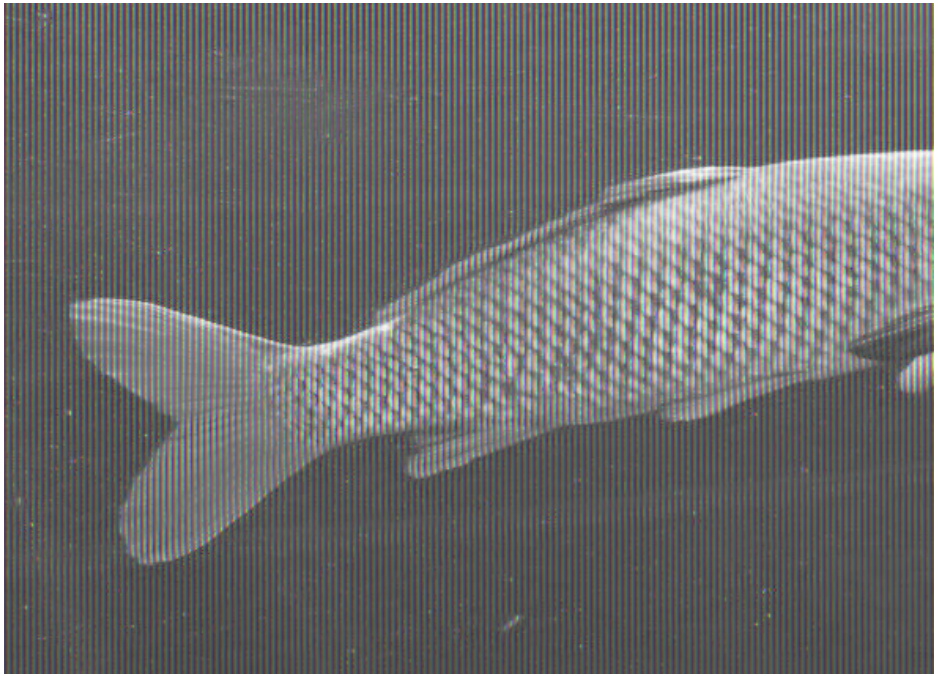
Temperature Range	Thrives between between 68° and 75° but can survive below 32° and up to 80° water temperature
Maximum Length and Weight	24 inches, 12 pounds
Life span	60 years
Stocking density	Each fish needs at least 5 gallons of water
Tank	Minimum 150 gallons; no less than 2’ deep and 2’ wide
Diet	Needs a diet with approximately 35% protein, can eat different types of small insects, small aquatic life, duckweed, algae and commercial fish food. Can also survive on a fully vegetarian diet at maturity
Top or bottom feed	Both
Dissolved Oxygen	Requires strong aeration (5+ppm)

EDIBLE CARP

COMMON, MIRROR + GRASS CARP

Benefits

- ❏ Similar to raising goldfish and koi except it is edible
- ❏ Can coexist with other fish in the same tank
- ❏ Withstands a wide temperature range, including freezing temperatures
- ❏ Hardy fish and relatively easy to raise
- ❏ Not popular in the U.S., but popular with immigrant populations (Chinese and Eastern Europeans)
- ❏ Typically raised as pond fish and relatively difficult to source



COMMON, MIRROR + GRASS CARP

Additional Characteristics

Temperature Range	Thrives between between 63° and 77° but can survive below 32° and up to 80° water temperature
Maximum Length and Weight	24 inches, 20 pounds
Life span	60 years
Stocking density	Each fish needs at least 5 gallons of water
Tank	Minimum 150 gallons; no less than 2’ deep and 2’ wide
Diet	Needs a diet with approximately 35% protein, can eat different types of small insects, small aquatic life, duckweed, algae and commercial fish food. Can also survive on a fully vegetarian diet at maturity
Top or bottom feed	Both
Dissolved oxygen	Requires strong aeration (5+ ppm)

TROUT

Benefits

- ❏ Popular edible fish
- ❏ Sells at a high price compared to edible fish
- ❏ Great food conversion ratio
- ❏ Survives only in cold water

Note

- ❏ Requires cold water to survive so can only be grown along with cool temperature crops
- ❏ Grows at a slower rate than tilapia, carp and catfish

TROUT

Additional Characteristics

Temperature Range	Ideal temperature is cooler waters between 57° and 60°, but will still survive if the temperature is between 50° and 64°
Maximum length and weight	16 inches, 8 pounds
Time to harvest	14-16 months (2 lbs)
Stocking density	Needs at least 2-5 gallons of water per fish
Tank	Minimum 150 gallons; no less than 2’ deep and 2’ wide
Diet	Requires 40% to 50% protein in diet, carnivorous
Top or bottom feed	Both
Oxygen	Requires strong aeration (10+ ppm)

TILAPIA

Benefits

- ❏ Most popularly farmed fish in the world
- ❏ Tolerates pH and temperature swings
- ❏ Great food conversion ratio
- ❏ Grows quickly
- ❏ Reproduces easily

Note

- ❏ Requires warm water shifts, needs cold water to survive.
- ❏ When females and males are in the same tank, excessive breeding occurs and males can become very aggressive.

TILAPIA

Additional Characteristics

Temperature Range	Optimal range is between 80 °and 86°, but can survive between 60° and 95°
Maximum Length and Weight	16 inches, 8 pounds
Time to harvest	8 months (2 lbs)
Stocking density	Needs at least 1-2 gallons of water per fish
Tank	Minimum 100 gallons; no less than 2’ deep and 2’ wide
Diet	Requires 22% to 35% protein, omnivorous, food options include duckweed, algae, and plankton
Top or bottom feed	Top only
Dissolved oxygen	Requires adequate aeration 5+ ppm

CHANNEL CATFISH

Benefits

- ❑ Withstands a wide temperature range
- ❑ Can coexist with other fish species in a tank
- ❑ Popular fish to eat in the U.S.
- ❑ Hardy fish and relatively easy to raise

Note

- ❑ Needs gentle handling due to lack of scales
- ❑ Can be difficult to raise in a recirculating system.

CHANNEL CATFISH

Additional Characteristics

Temperature Range	Optimal range is between 65° and 90°, but can survive between 30° and 95°
Maximum Length and Weight	24 inches, 50 pounds
Time to Harvest	9-12 months (2 lbs)
Stocking Density	Needs at least 2 gallons of water per fish
Tank	Minimum 200 gallons; at least 3 feet deep and 2’ wide
Diet	Requires 32% - 38% protein, omnivorous, eat snails, insects, commercial feed and algae
Top or Bottom Feed	Both
Dissolved Oxygen	Adequate aeration required at least 2+ ppm

BLUE GILL

Benefits

- ❑ Withstands a wide temperature range
- ❑ Good alternative to tilapia for cooler climates
- ❑ Hardy fish and relatively easy to raise
- ❑ Reproduces rapidly
- ❑ Hardy fish and relatively easy to raise
- ❑ Fast grower

BLUEGILL

Additional Characteristics

Temperature Range	Optimal range is between 60 and 80°, but can survive between 32° and 90°.
Maximum Length and Weight	12 inches, 4.5 pounds
Time to Harvest	9-12 months (2 lbs)
Stocking Density	Needs at least 2 gallons of water per fish.
Nutritional Benefits	Bluegill ia a good source of protein and provides omega 3 fatty acids along with calcium, potassium and vitamin D.
Diet	Requires 35% - 45% protein, omnivorous; diet includes algae, aquatic vegetation, zooplankton, insects, insect larvae and commercial feed.
Top or Bottom Feed	Both
Dissolved Oxygen	Requires adequate oxygen (4+ ppm)

GIANT FRESHWATER PRAWNS

Benefits

- ❏ Freshwater prawns also known as Macrobrachium Rosenbergii
- ❏ Good alternative to raising fish
- ❏ Can coexist with fish in the same system
- ❏ Helps break down organic matter - dead plant roots, dead insects etc - in the tank
- ❏ Withstands a wide temperature range, but not freezing temperatures
- ❏ Hardy and relatively easy to raise

GIANT FRESHWATER PRAWNS

Additional Characteristics

Temperature Range	Can survive between 57° and 105°, though ideal range is between 78° and 84°
Maximum Length and Weight	9 inches, 0.1 pounds
Time to Harvest	5 to 6 months
Stocking Density	20 juvenile prawns per square foot of surface area, at 3 months, only 2 prawns per square foot of surface area
Tank	Minimum 40 gallons
Diet	Requires 30% to 45% protein diet, omnivores, can digest a wide array of foods, organic waste
Top or Bottom Feed	Bottom

References & Resources

PURCHASING & INFO (FISH)

Live Aquaponics

Backyardtilapia.com

Aquaculture of Texas

Lakeway Tilapia

Go Green Aquaponics

Leafin