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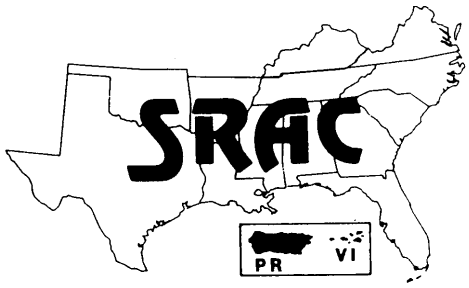


May, 1989

4-H Aquatic Science Project

Guide to Raising Catfish in a Cage

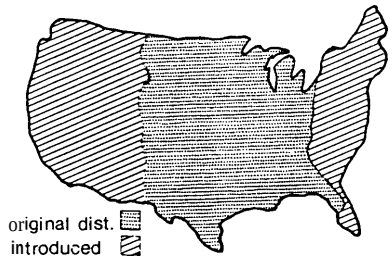
T.E. Schwedler, Marcia L. Berry and Donnie R. King *

The catfish project is designed to familiarize 4-H'ers with production techniques ingrowing catfish in a cage. This project requires three things: access to a pond with the right characteristics, supportive parents, and dedicated persistent youth to care for the fish for the entire growing season. Four-H'ers will learn to construct a cage and how to feed the fish properly, to keep record, and to harvest and market their fish.

The project should begin in April and conclude in November, with 4-H'ers feeding the fish every day during this period.

Channel catfish originally were found only in northern Mexico, the Gulf States, and the Mississippi Valley north to the prairie provinces of Canada. Since then they have been introduced throughout the United States and many other countries.

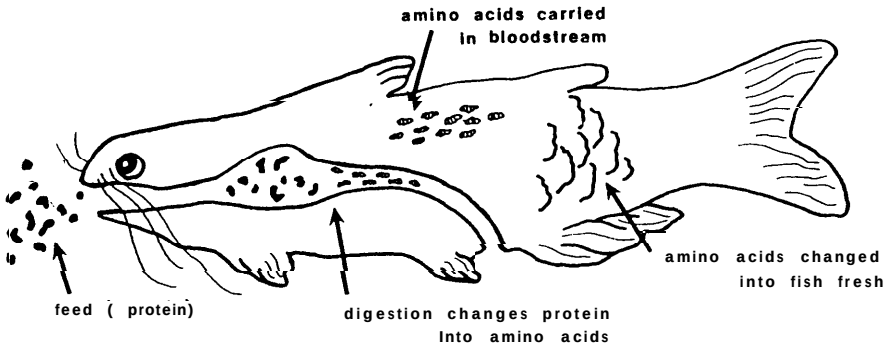
Although channel catfish are freshwater fish, they can live in somewhat salty water. In natural waters they live in moderate to swiftly flowing streams but are found also in lakes and some sluggish waters. Usually they are found where the bottom is sand, gravel, or rock, which they prefer to a mud bottom. Seldom are they found where aquatic weeds grow thickly.



Map shows original distribution of cat fish and its present introduction.

Feeding habits of catfish

In their natural habitat (home) channel catfish will eat a wide variety of both plant and animal materials. Feeding can take place during the day or night. Most of the time they feed near the bottom in natural waters, but they will take some food from the surface.



* Clemson University

Young catfish feed mainly on aquatic insects. But adults have a much more mixed diet that includes insects, snails, crawfish, green algae, aquatic plants and small fish. In fact, fish become an important part of the diet for channel catfish larger than 18 inches long, and in natural waters fish may make up as much as 75 percent of their diet.

Several factors control hunger in channel catfish: temperature, oxygen concentration, time of last feeding and general health status. Once the catfish is hungry, it uses most of its senses to locate food: hearing, touch, taste, smell, sight (and its lateral line system), which detects movement at a distance.

Dietary essentials

The diet of catf~h must include protein, carbohydrates, fats, vitamins and minerals. If the catfish do not eat these nutrients in the correct amounts, they will not grow.

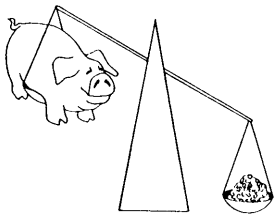
Protein is needed to build flesh (muscle). All proteins are made up of 20 basic building blocks called amino acids. Different types of proteins are made by varying the order of these 20 amino acids.

Digestion

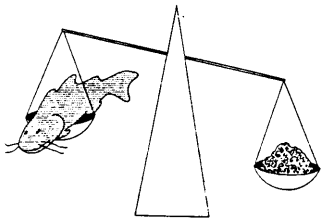
When a catfish digests food, it breaks down the protein into amino acids so they can be carried through the blood to the cells, where the amino acids are reassembled in the right order to make catfish proteins.

The energy needed to make the amino acids into protein enters the catfish as carbohydrates and fats. The catfish needs to eat enough carbohydrates and fats to supply enough energy to make proteins efficiently. The catfish stores extra energy as fat to use when enough food is not available.

Other important parts of catfish feed needed to build proteins are minerals and vitamins. These are also called micronutrients (micro = small) because only small amounts are needed. But without these minerals and vitamins, catfish proteins cannot be made.



l-lb gain per hog 3.25 lb feed



l-lb gain for catfish 1.5 lb feed

Catfish need 1.5pounds of feed for a l-pound gain; hogs need 3.25 pounds of feed for a 1-pound gain.

Feed conversion

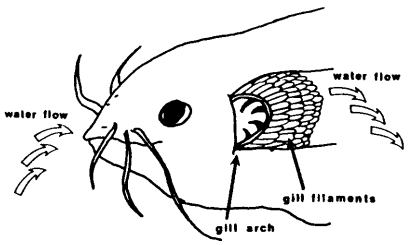
FCE (Feed conversion efficiency) is the number of pounds of feed a catfish eats to produce 1 pound of gain. For example, a 1.5 to 1 conversion ratio means that it takes 1.5 pounds of feed to get 1 pound of catfish production. Catfish convert very well compared to land animals; for example, hogs convert 3.25:1.

Respiration

Catfish, like other living animals, need oxygen to survive. The oxygen is used for making energy and for growth. Catfish take oxygen out of the water with their gills just as people take oxygen out of the air into their lungs. The gills also get rid of gaseous wastes such as carbon dioxide (CO_2).

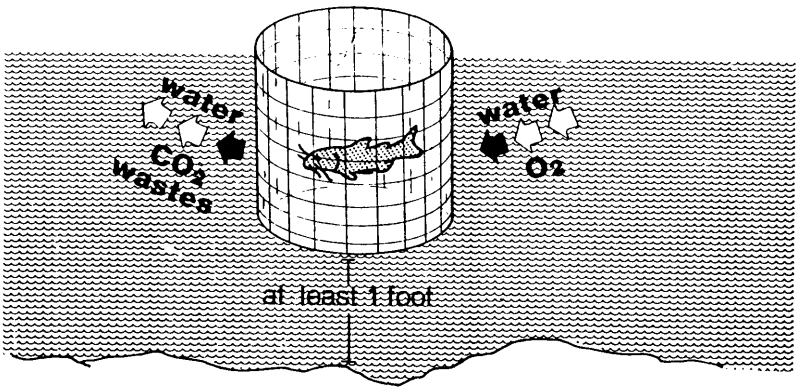
Gill structure

Located on each side of the catfish's head, the gills are covered by a flap of skin and muscle called the gill flap. Four gills are located on each side of the head. Each gill is made up of a double row of gill filaments supported by a white gill arch.



Breathing

A fish breathes by sucking water in through the mouth where it flows over the gills. Blood in the heart is low in oxygen, but the water at the gill is high in oxygen. After oxygen crosses the gill, it enters the blood and is carried through the fish's body.



Water movement brings oxygen into the cage and carries away wastes.

Table 1. Determining size of transport container by size of fish, weight per fish, and weight per thousand fish.

Fish length inches	Lbs/fish	Lbs/thousands
3	.01	10
4	.02	20
5	.032	32
6	.06	60
7	.093	93
8	.112	112
9	.180	180
10	.328	328

Once the number of fingerlings has been established, determine the approximate size of the fingerlings available. The fingerling supplier should know the size of the fingerlings. See Table 1 to find the approximate weight of 1,000 fish. Then the size of the transport container needed can be determined from this information.

Sampling fingerlings

Estimate the number and size of the fingerlings when they are picked up. A sample of fish (10 percent) should be taken and weighed.

First, weigh and record the weight of a 5-gallon bucket half filled with water.

Add the sample of fingerlings to the water and record the total weight of the bucket, water, and fingerlings.

Total weight (bucket, water, fingerlings) - beginning weight (bucket and water) = weight of the fingerling sample

Once the weight of the fingerling sample is measured, count the fingerlings individually and record the number in the weighed sample.

To determine how many pounds of fingerlings you need for the desired stocking rate of 300 fingerlings, calculate the weight per fish from the sample weight and number.

Sample weight (pounds) ÷ number of fish in sample = average weight per fingerling

For example, let's assume your sample weight was 9 pounds and you counted 150 fish.

9 pounds ÷ 150 fingerlings = 0.06 pound (slightly less than 1 ounce)

Using the following formula, you can calculate the weight of 300 fingerlings: Average weight (.06) x (300) number of fingerlings needed = 18 pounds to buy.

Transport container size

The fingerlings will have to be transported to your cage in well-aerated water (water with a lot of oxygen available to the fish). Loading rates for shipping catfish fingerlings in well-aerated water is 1 pound per gallon of water.

To determine the container size needed to transfer 300 fish at 0.06-pound average or 18 pounds total weight:

Divide 18 pounds of fingerlings by 1 pound of fingerlings per gallon of water = 18 gallons of water.

The fish displace 1 gallon of water per 8 pounds of fish; so you need a container large enough to hold 18 gallons of water + the number of gallons taken up by the fish.

Divide 18 pounds of fingerlings by 8 pounds of fingerlings per gallon to get 2.2 gallons of fish.

2.2 gallons of fish + 18 gallons of water = 20.2-gallon container

The container can be constructed of wood, metal, or any nontoxic material.

If a nonaerated container (one that does not have oxygen being pumped in) is used, the loading rate should not exceed the amount of oxygen in the water.

The shipping time (the amount of time it will take you to get the fish back to your cage after purchasing them) greatly influences how many fish can be transported.

For example, one hour of transporting 18 pounds of fish in a nonaerated container would require 565 gallons of water.

Transporting fish

Catfish are transported best in cool water below 70° F. The temperature of the water in the container should be the same as the water the fingerlings are in (within 5° F). Ten ounces of table salt for every 100 gallons of water should be added to the water to help prevent stress and help remove parasites during transport. The fish are then weighed (18 pounds in our example) and placed in the shipping container. They should be transported as quickly as possible to your pond.

Stocking your cage

When the fingerlings arrive at your pond, check the temperature of the water in the pond and in the shipping container. If the temperatures are within 5° F of each other, start stocking. But if the temperatures vary by more than 5° F, slowly

replace the water in the container with pond water until the temperatures are equal. Once the temperatures are adjusted, you can stock the fish by dip netting and placing them directly in the cage.

Feeding catfish in cages

Consistent feeding is important to insure good growth and maintain a healthy condition. Feed the fish every day and keep records on how much feed is consumed. Feeding a high quality (32 percent protein) floating catfish feed with all essential vitamins and minerals is also important (See sections on Feeding habits of catfish and Dietary essentials).

Since catfish are cold-blooded animals, this means their body temperature is the same as the water. As the temperature of the water decreases, feeding activity also decreases. When the water is above 70° F, catfish feed well and convert their feed efficiently. Therefore, when the temperature is above 70° F, it is considered the growing season, and the catfish should consume at the recommended feeding rate. *(If catfish that are feeding well suddenly slow down when the temperature is above 70 ° F, they may be sick.)* If this happens, contact your county Extension office for assistance in determining why.

Table 3. Amount to feed fish based on their average weight-300 fish

Pounds		Approx.
Avg. wt / fish	Feed/day	cups per day
.050	0.4	1.25
.060	0.5	1.50
.070	0.6	1.75
.085	0.7	2.20
.095	0.8	2.50
.110	0.9	2.80
.120	1.0	3.13
.150	1.2	3.75
.175	1.3	4.00
.200	1.5	4.70
.230	1.7	5.30
.260	2.0	6.25
.300	2.2	6.90
.340	2.5	7.80
.390	2.8	8.75
.440	3.1	9.70
.490	3.4	10.80
.550	3.7	11.60
.610	4.1	12.80
.680	4.4	13.80
.750	4.7	14.70
.820	5.0	15.60
.900	5.7	17.80
1.070	5.9	17.80
1.160	6.4	20.00
1.250	6.9	21.60

Table 2. Estimated percent of body weight consumed by various sizes of channel catfish when water temperature is above 70°F (use percentage until next size is reached)

Average weight / fish (pounds)	% Body weight consumed
.02	5.00
.04	4.00
.06	3.00
.25	2.75
.50	2.50
.75	2.25
1.00	2.00
1.50	1.75

It is best to feed catfish in cages once every day at about the same time. Abrupt changes can cause them to feed erratically. If you notice feed left over from the previous feeding, reduce the amount slightly until they are eating all of it. Feeding on the surface is not natural for channel catfish; they have to be trained to eat on the surface. It may take several weeks to get them to feed well.

Use the 4-H catfish feed record system to figure how much to feed. If you do not have a scale to weigh

How fast the fish breathes depends on how much oxygen is needed. Fish that are under stress or that are being chased need more oxygen than fish that are resting. Also, if the amount of oxygen in the water is low, the fish have to breathe faster to get all the oxygen they need.

Oxygen requirement

The most important environmental requirement is oxygen. Oxygen dissolved naturally in water can come from two sources: (1) as a by-product of plant growth or (2) dissolved from the air. At the same time water movement carries oxygen into the cage, it also carries away wastes produced by the catfish.

Preparing a budget

To prepare a budget for your cage operation, include all costs spent on starting and maintaining the project and the income received from selling the fish. Also include your profit, the difference between costs and income.

Costs include cage materials, fingerlings, feed and other items such as a scale and a net listed below:

Costs

Cage materials	$15.00*
Fingerlings 300 @ $.15 ea	45.00
Feed 450 lb@ $.15 lb =	67.50
Miscellaneous (scale, net)	15.00
Total	142.50

*Actual cost of cage $45.00, used for 3 years = $15.00 per year.

Income is the amount of money taken in from the sale of the catfish after harvest. The total weight of the fish sold at each price should be recorded.

Income

100 lb at $.75 =	$75.00
100 lb at .80 =	80.00
100 lb at .85 =	85.00
Total	$240.00

The *profit* you may realize from your project would be shown as follows:

Profit

Income	$240.00
Costs	-142.50
Profit	$97.50

Cage construction

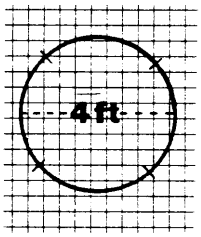
To make a cage for this project, you need certain materials and instructions.

Materials needed

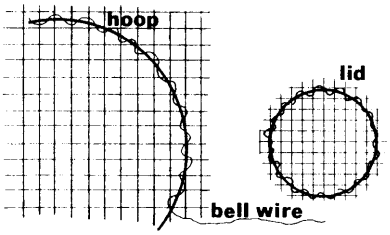
- Welded plastic net (1/2 inch) - 13 feet × 4 feet
- Two pieces welded plastic net (1/2 inch) - 4 feet × 4 feet
- Welded plastic net (1/8 inch) - 13 feet × 1 foot
- Three 4-foot-diameter hoops; 130 feet 18-gauge bell wire
- Four plastic jugs

Making the lid

- Place 4-foot hoop on l/2-inch, mesh-welded plastic net 48 inches × 48 inches.
- Temporarily tie all four sides of the hoop to the net with a triple knot.
- Cut about a 6-foot section of bell wire and tie securely to the hoop and net.

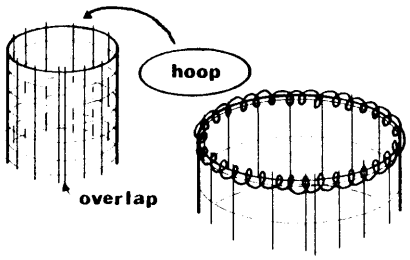


- Sew the hoop to the net, spacing stitches no more than every other mesh.
- Continue until about 4 to 6 inches of bell wire remains and tie off securely to the hoop.
- Cut another 6-foot section of bell wire and tie off to the hoop and net overlapping the knot you have just tied.
- Continue until the hoop is completely sewn to the net and tie off securely.
- Cut the excess net off the lid; be careful not to cut too close to the hoop.



Sides of cage

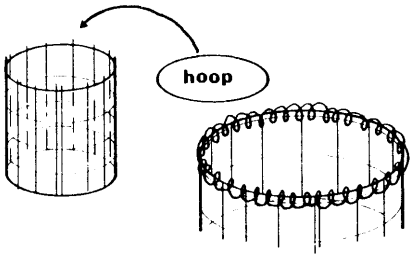
- Take the 13- × 4-foot piece of l/2-inch mesh net and stand it on one end, forming a cylinder.
- Take a hoop and temporarily tie with short pieces of bell wire to the top of the net.
- Begin sewing the net to the hoop as described for the lid, tying off a 6-foot piece about 2 inches from the seam.
- Continue to sew the hoop to the top of the net.



Bottom of cage

- Tip the cage over so the hoop you have just attached is on the floor.
- Take the final hoop and attach it temporarily to the top (bottom) of the net.

•Place the final 48- × 48 inch section of l/2-inch mesh net on the cylinder on top of the hoop.



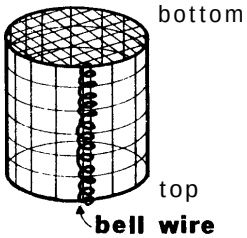
•Begin to sew the hoop to both nets (the bottom panel and sides of the cylinder).

•Again use 6-foot sections and do not skip more than 1 mesh for each stitch.

Closing seam on cage

. Tie the bell cable to the bottom hoop and sew the two pieces of the seam together.

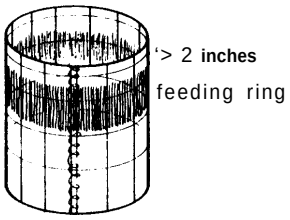
● Continue until you reach the top hoop and tie to the top hoop.



Installing feeding ring

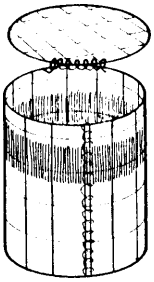
ŽTake the 13- × l-foot piece of l/8-inch mesh and attach it to the sides of the cage about 2 inches from the top hoop.

•Sew it on with 12-pound or more monofilament fishing line and attach to the l/2-inch mesh net and close the seam.



Attaching lid

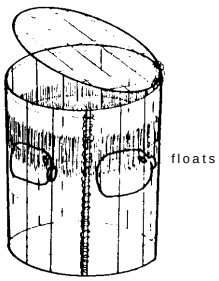
Attach the lid hoop to the top hoop of the cage at several places with several short pieces of bell wire.



Attaching floats

•Glue the caps of gallon jugs to the tops of the jugs so they do not leak.

•Tie the jugs to the sides of the cage with bell wire so that 6 inches of the cage floats out of the water.

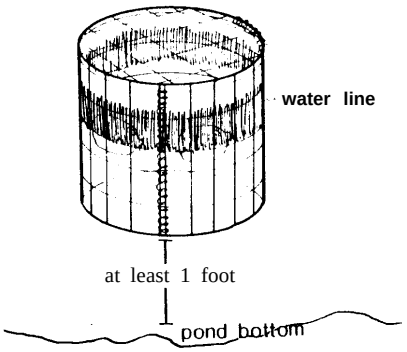


Cage placement

For your channel catfish cage, choose a pond at least one-half acre or larger. Also, it should be at least 5 feet deep where the cage is set. Place the cage so that the bottom is at least 1 foot from the pond bottom. This helps to get rid of waste products. Anchor the cage securely where water and air circulate freely and where waves can move water through the cage from any direction. This is important to bring oxygen into the cage and to remove wastes. Attaching the cage at the end of a dock or pier makes feeding and observation easy.

Number to stock

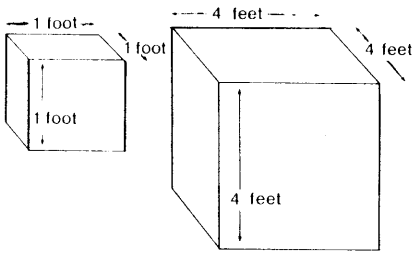
Base the number of catfish to be stocked in cages in a pond on the surface area of the pond. You can stock about 1,000 catfish fingerlings (4 to 5 inches long) per acre of water. For example, in a 1.5-acre pond you could stock as many as 1,500 fingerlings (1.5 × 1,000). The number of fingerlings per cage is derived by cage size.



Anchor cage securely where water and air circulate freely.

Stocking rate

This is the number of fish you can grow in your cage. Determine the number of cubic feet in a cage; the stocking rate is based on this number. (Maximum stocking rates should be between 6 to 10 fish per cubic foot or 384 to 644) fish in the 4 × 4 × 4 foot cage shown in this publication).



Calculation: Length × width × depth --4 feet × 4 feet × 4 feet = 64 cubic feet

The round cages designed for the project, 4 feet in diameter, have 50 cubic feet. The stocking rates should be between:

6 × 50 or 300 fish

to

10 × 50 or 500 fish

Table 4. Simulated growth showing projected fish size at weekly intervals

No. weeks caged	Pounds	
	Avg. wt / fish	Total wt /300 fish
0	.048	14.4
1	.052	15.7
2	.062	18.5
3	.073	18.5
4	.085	25.2
5	.098	29.3
6	.113	34.0
7	.131	39.4
8	.153	45.8
9	.176	52.7
10	.202	60.6
11	.231	69.3
12	.263	79.1
13	.300	90.0
14	.341	107.4
15	.388	116.5
16	.438	131.4
17	.493	148.0
18	.550	165.0
19	.614	184.5
20	.682	204.9
21	.752	225.7
22	.825	247.8
23	.906	272.2
24	.987	296.6
25	1.068	321.0
26	1.156	347.3
27	1.251	375.8

the food, use a volume measurement (measuring cup). Begin by measuring a cup of feed and weighing it. For example, a 32-percent floating feed may weigh .32 or 1/3 pound per cup. If you need to feed 1/2 pound, give 11/2 cups. If you need 3/4 pound of feed, use 2 1/4 cups.

Pounds of feed needed ÷ pounds of feed per cup = number of cups to feed

Check Table 2 regularly to see if your catfish are eating at about the correct rate. A slight difference between your fish and the table is okay. However, if feeding activity is much different, call your county Extension office.

Disease identification

Preventing diseases is important. Often fish diseases are related to stress. You can avoid stressing the fish by handling the fingerlings properly when transporting and stocking them, by feeding them a complete diet, and by maintaining good water quality.

If diseases do appear, the fish can be treated. The first sign of disease is usually a decrease in feeding activity or a total failure to feed. Other signs may be open sores, frayed fins and swollen bellies. If you see any of these, contact your county Extension agent immediately.

Harvest time

The catfish are ready to harvest anytime they weigh over 1 pound. Some individual fish will reach 1 pound when the average weight reaches about 3/4 pound. You can remove the larger fish over 1 pound at this time, but do not handle them too much. You could damage the other fish and decrease their overall production.

Taste testing

Test your catfish for off-flavor. This is a bad taste in catfish flesh that comes from algae in the pond. Off-flavor makes the fish taste muddy. Selling off-flavor fish will greatly hurt your marketing efforts. To test for off-flavor, remove a fish from the cage about a week before harvesting and dress it. Cook it in the microwave or regular oven without seasoning. The fish should taste bland with no muddy taste.

If the fish tastes muddy or has other unwanted flavors, postpone harvesting and taste a fish each week until the flavor is satisfactory. Usually when the water turns cool, the algae causing off-flavor will go away and not affect the fish.

Marketing

When the catfish reach 3/4 to 1 pound, they are ready to sell. You can expect 5- to 6-inch-long fingerlings to be at this size in 21 to 24 weeks. (Allow more time at northern latitudes.) The catfish may be sold live or processed (dressed). To sell dressed fish, inspection of facilities

may be necessary depending on state and local laws. Contact your county Extension agent for details. It is a good idea to arrange for selling your catfish weeks in advance of harvest.

You may want to try selling first to neighbors, friends and relatives. This would allow you to establish a fair price that takes into consideration your costs and labor. The price for dressed fish should be different from the price for whole or live fish. When selling your fish, you may want to stress that they will be fresh, were grown in your local area and were fed a balanced diet.

You can announce that you have catfish for sale by using signs in your front yard or by putting an ad in your local paper.

Also, you may consider selling live catfish to "fish-out lakes" in your area if you have a safe way to transport them so they arrive healthy. Call clients before you harvest and tell them when the catfish will be available. Decide on a delivery date, the number of fish to be ordered, and a price per pound in advance.

Harvesting

Before harvest, withhold feed for at least 2 days to allow the fish to empty their intestine. This will make processing much easier and cleaner.

A large deep dip net with a large mesh size can be used to remove fish from the cage. Be careful not to let the fish jump out of the net over open water because they will be lost if you do.

Surprisingly, the fish can be hard to catch even though you have 300 pounds plus in your cage. If you want to harvest the entire cage, bring the cage into shallow water (about waist deep). Then dip out the desired fish, count, and weigh. Record the numbers on the harvest record sheet.

If you do not have a scale, a gallon bucket can be used to "weigh" the fish. Mark the gallon bucket at 1-pint intervals (1 pint = 2 cups). Add pond water to the bucket and bring it up to one of the lower pint marks. Place one fish in the bucket. One pound of fish will displace 1 pint of water and make the water move up one mark in your bucket.

Keeping fish fresh

After-you remove your high-quality, farm-raised catfish from the cage, take care to keep them fresh until they reach the table. If the fish are to be dressed quickly, they can be kept fresh simply by placing them in a clean, wet burlap bag. The fish will remain alive and fresh for about 30 minutes to an hour.

The best way to keep them fresh is to place them on ice in an ice chest. They will remain fresh up to 2 to 3 hours. Do not place the catfish in water unless the tank is very large or is aerated. For example, to keep three l-pound fish alive for 1 hour without aeration would require 100 gallons of water. With proper aeration, 4 pounds per gallon can be safely hauled alive. Call your local county Extension agent if you have requests for selling fish that need to be transported.

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