Managing Farm Ponds for Fishing

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Fact Sheet 19 | Forestry and Natural Resources | Revised May 2009

South Carolina has numerous farm ponds that are used for irrigation, watering livestock, and recreation. Even though most of these ponds are not used for recreational activities, they could provide excellent fishing opportunities if they were properly managed.

Ponds can be managed to attract wildlife and to provide a variety of recreational activities, including swimming, fishing, and aesthetics. It may be difficult to manage for all of these things simultaneously, so the pond owner must decide what activity is the most important and structure management decisions around that goal.

If the pond is managed for recreational fishing, this chapter should help you understand how ponds work and the basic principles of managing farm ponds.

Understanding How Ponds Work

Small farm ponds are man made and not natural environments. They must be carefully managed to provide productive, recreational fishing. Think of a pond as a garden or an orchard. It must be properly laid out, fertilized, seeded (stocked), weeded, pruned (selectively harvested), and protected from acts of nature (e.g., oxygen depletions) to be bountiful.

Good pond management includes:

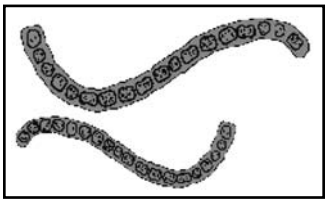
- enhancing food availability for fish,
- controlled harvesting to maintain the balance of predator and prey populations,
- controlling weeds, and
- preventing situations that may cause fish kills.

These are not simple tasks. Ponds are complex ecological systems and require personal commitment and insight for productive management.

No two ponds are exactly alike. Ponds close to one another, but on the same watershed (surrounding area from which the pond receives rainfall or water drainage), will be slightly different. These differences are not well understood. However, we do know that soil characteristics and localized variations in the watershed are unique for each pond. Factors critical to managing a pond include:

- plankton,
- fish populations, and
- water quality.

Plankton, the microscopic and near-microscopic organisms that are suspended in the water of a pond, are important because they are essential to the creation of oxygen in a pond. Fish need oxygen to survive, and oxygen is not freely available in pond water. It must dissolve into the water before it becomes available to the fish. Dissolved oxygen comes from the air or through the process of photosynthesis. Aquatic plants, primarily phytoplankton and other algae, release oxygen directly into the water as a by-product of photosynthesis, the most important source of oxygen in water.



Plankton are classified as phytoplankton (plants) and zooplankton (animals). All phytoplankton are algae; however, not all algae are phytoplankton. Both phytoplankton and zooplankton are important in fish pond management.

Phytoplankton, at the bottom of the aquatic food chain, are eaten by zooplankton and insects. Small fish eat the zooplankton and insects. Small fish are food for larger fish (the ones you are trying to catch). An adequate phytoplankton population is essential for producing a large and healthy fish community.

The color or clarity of pond water can be related to plankton populations or to suspended sediments and organic matter. Productive water (water that will support healthy fish populations) has a green tint that is produced by chlorophyll pigments contained in the billions of phytoplankton suspended in the water. A large population of phytoplankton is called a bloom. These blooms can die off or "crash" rapidly. This causes the water to appear dark or black. When this happens, the dead phytoplankton begin decaying. This process uses oxygen and may reduce oxygen to levels at which fish are stressed or die. Phytoplankton die offs are common in deep hillside ponds or ponds where manure or fertilizer from the watershed drains into the pond.

Sediments (silt, sand, or dirt) washed into ponds after heavy rains can also change pond color. Normal color should return within a few days as the particles settle. Ponds that receive too much sediment can become unproductive. This situation can cause fish to die because plants become shaded (reducing the amount of sunlight available for photosynthesis and oxygen production). Also, fish gills can become clogged with the sediment particles, making it difficult for fish to breathe.

Water Quality

Pond dynamics are also affected by water quality. Factors such as pH (whether the water is acid or base), alkalinity, and dissolved oxygen affect fish health and pond productivity. Some aspects of water quality fluctuate daily, weekly, or monthly. Dissolved oxygen and pH cycle each day. Alkalinity can change over a period of time, ranging from several weeks to months, depending on the pH of the watershed or soils on the bottom of the pond.

As discussed earlier, photosynthesis is critical to the production of oxygen in a pond. Because photosynthesis is driven by the energy in sunlight, oxygen production does not occur at night. Therefore, dissolved oxygen levels rise throughout the day. After sunset, oxygen slowly declines as plants and animals consume oxygen to breathe (respiration). In a well-managed pond, nighttime dissolved oxygen levels should not fall below 3 or 4 parts per million (ppm or mg/l). Oxygen levels below 3 ppm stress fish, and many species may suffocate and die when oxygen levels fall below 2 ppm.

Pond pH varies over the course of a day as a result of respiration and photosynthesis. The carbon dioxide released from respiration reacts with water, producing carbonic acid. During nighttime, more carbonic acid is formed because plants are now respiring (more carbon dioxide is produced). The pond becomes more acidic and pH is lowered. Acidic pH levels vary from 1 to 6.9. The lower the number, the more acidic a compound is as a liquid. During daylight, phytoplankton use carbon dioxide in photosynthesis. This reduces acidity and increases pH. Pond pH normally fluctuates between 6.5 and 9. If the pH drops below 5 (e.g., perhaps because of acid runoff in mining areas) or rises above 10 (low alkalinity combined with enhanced carbon dioxide removal by dense phytoplankton or algal blooms), fish may become stressed and die.

Alkalinity is related to pH. The amount of base (something like baking soda) in water defines what is known as alkalinity. These bases, usually bicarbonates, react with acids and minimize pH changes. Alkalinity can increase the availability of carbon dioxide and other nutrients to phytoplankton. A total alkalinity of 20 ppm or more is necessary for good pond productivity.

Basic Principles of Fish Pond Management

Good fishing in farm ponds depends on an understanding of and the ability to follow some basic rules. To properly manage farm ponds for fishing, you should be aware of some simple guidelines:

1. proper pond construction and watershed management;
2. removal of unwanted and overpopulated species of fish;
3. liming and/or fertilization;
4. fish species selection and stocking;
5. harvest and record keeping;
6. evaluation of pond balance; and
7. weed control.

Pond Construction and Watershed Management

One of the first principles of good pond management is the proper construction of the pond. Poorly constructed ponds are hard to manage. Water levels may change dramatically if there is seepage or if the watershed area is not large enough. Shallow areas may cause aquatic weeds to grow and spread rapidly. In addition, erosion and contamination from the watershed may make pond management difficult or impossible.

A good farm pond in South Carolina should have 3 to 5 acres of watershed per acre foot of pond volume. Ponds supplied by a watershed covered with forests require more area than ponds on field or pasture watersheds. Spring-fed ponds can be located on smaller watersheds. If the pond is placed in an area where the watershed is too large, an encircling diversion ditch can be used to prevent or minimize rapid pond flushing (changing or movement of water through a pond).

Shallow areas, less than 2½ feet deep, stimulate aquatic weed growth by allowing sunlight to reach the pond bottom. To remedy this problem, pond banks should be built with slopes of 2:1 or 3:1 ratios (horizontal distance to height). Levees should be high enough to allow a minimum depth of 2½ feet.

Livestock can cause severe erosion damage on pond banks and levees. The eroded sediments slowly fill the pond and create shallow areas enhancing weed growth. In addition, animal wastes may wash into the pond during periods of heavy rainfall. This can cause water pollution or nutrient overload problems. To prevent this from happening:

- locate livestock watering areas below the pond,
- do not allow livestock to graze or roam on watershed land, and
- fence the pond to keep cattle away.

Ponds should also be separated from agricultural row-crops or fields by a grass barrier. Pesticides, herbicides, and contaminated soils or vegetation can wash into a pond and kill fish. By placing grass strips 50 to 100 feet wide around the pond, you can reduce soil erosion and chemical runoff from neighboring pastures and fields.

A common problem with farm ponds is leakage due to improper construction. Soils for pond construction must contain a minimum of 20% clay, and the dam should be constructed with a compacted clay core. Trees or other woody vegetation should not be permitted to grow on pond dams. Ponds should have a drain so you can easily regulate water levels. Contact the local U.S.D.A. NRCS office for more advice and help on farm pond design.

Fish Removal

People do not usually catch many fish from ponds that are poorly managed or ignored. Fish populations often become imbalanced or contaminated with unwanted species. Typically, unmanaged ponds become crowded with small, stunted green sunfish or bullhead catfish. The best remedy in these situations is to eliminate all fish and start over. Destroying unwanted fish is easy and inexpensive, and it requires less

chemicals if the pond is partially drained and the fish are concentrated. However, fish can survive in small puddles. Treat all puddles regardless of size.

Rotenone is a registered aquatic chemical which can be used to kill fish. Contact the SCDNR district fisheries biologist, or Extension aquaculture specialist for information about purchasing and applying rotenone.

Rotenone dissipates from the water within 3-20 days depending on water temperature and weather conditions. Generally, it is safe to stock fish 2 weeks after applying rotenone during spring, summer, and autumn. To check for residual rotenone, place a few small fish in a minnow bucket and float them in the pond. If the fish are alive after 24 hours, it is safe to stock fish.

Pond Fertilization

Just as you would fertilize fields to increase crop yields, you should fertilize a pond to provide phytoplankton with adequate nutrients for growth. Proper fertilization increases food availability throughout the food chain and indirectly increases the total amount of fish a pond can support. Ponds should be limed before fertilizer is applied. Liming is important because it increases pH and alkalinity. Even without fertilization, this may improve available nutrients which can support a phytoplankton bloom.

Fertilizing ponds will increase fish production by a factor of two or three. Infertile ponds will seldom produce more than 200 pounds of fish per acre. Well-managed, fertile ponds will support 300 to 600 pounds of fish per acre. If the pond is not fished often or if the pond receives some natural fertilization, use half the recommended fertilizer rates, or do not fertilize at all (Table 1 lists application rates for commercially available fertilizers). Once you start a fertilization program, it should be continued, or fish growth may become stunted due to reduced food supply.

Fertilizers are labeled with N:P:K ratios or the percent composition of nitrogen (N), phosphorus (P), and potassium (K). The equivalent of 8 pounds of phosphate per acre is a commonly recommended treatment rate (Table 1). You should be aware that not all fertilizers work well in ponds because they may not contain enough of the limiting mineral. In most ponds, phosphorus is usually the limiting nutrient. It becomes unavailable to phytoplankton because it is tied up by bottom sediments as a result of chemical precipitation and decomposition. The phosphorus in the bottom sediments then promotes rooted weed or algae growth. Nitrogen is rarely limiting in older ponds. New ponds may need nitrogen; however, once a pond is established it should not need nitrogen.

Lime Before Fertilizing

Fertilization will not stimulate a good phytoplankton bloom if alkalinity is below 20 ppm. Check the alkalinity in the pond before applying fertilizer. If alkalinity and pH are low, the addition of powdered, agricultural limestone should raise pH and alkalinity. Do not use quick or slaked lime because these compounds can cause rapid pH changes which may kill the fish. The amount of lime needed depends on chemical characteristics of bottom sediments or mud. You must take a soil sample from the pond bottom and have it analyzed to determine how much lime is required.

Table 1. Recommended pond fertilization rates (lbs/acre) on a per-treatment basis.

Fertilizer Formulation	Application (pounds/acre)
20-20-5	40
16-20-4	40
18-46-0	18
13-38-0 (liquid)	20
10-34-0 (liquid)	20
0-46-0	18

To take a soil sample, collect mud from several locations in the pond. Combine and mix the samples, then spread the soil out to dry. After it has completely dried, send the combined sample for analysis to the Clemson University Soil Testing Lab. Your local County Extension Agent can assist you in processing your soil sample at Clemson University. Mark the sample "pond mud" so the right tests can be conducted. The analysis report you receive will indicate how much lime you should apply.

Another way to estimate the amount of lime required in ponds is to apply 1¼ to 1½ times the amount of agricultural lime used for crops in nearby areas. It is not possible to over treat a pond with agricultural limestone because limestone does not dissolve once the pH reaches 8.3.

Contact your county Extension office to determine the best method of applying lime. Lime must be spread evenly over the entire pond so it can react with the bottom mud. Because limestone dissolves slowly and is washed out of the pond with overflow water, repeat treatments every 3 to 5 years. Another alternative is to spread ¼ the original application of lime into the pond each year.

When to Fertilize

One simple method used to determine when to fertilize measures the clarity of pond water. The depth of light penetration in water is a good indicator of the phytoplankton density or bloom. Light penetration can be measured using a **Secchi disk**. A Secchi disk can be made from an 8 inch diameter disk of plywood, metal, or plastic. Mark the disk into four equal sections and paint each set of opposing quarters white and black, respectively, so that it is visible underwater. Attach the disk to the bottom of a broomstick or pole with the painted surface facing up toward you. Paint a line on the pole at the distances of 12, 18, and 24 inches from the disk.

Lower the Secchi disk into the water until it just disappears from sight and record that depth. Use Table 2 as a fertilization guide based on Secchi disk measurements. Low Secchi disk readings in muddy water (suspended sediments) are not reliable estimates of phytoplankton blooms.

Table 2. Recommendations for pond fertilization and management based on Secchi disk measurements.

Secchi Disk Measurement	Recommended Management
24 inches or greater	fertilize
18 to 24 inches	good bloom - do nothing
12 to 18 inches	dense bloom - watch
6 to 12 inches	bloom too dense - find cause; prepare to aerate
6 inches or less	oxygen depletion likely; nighttime aeration is indicated

If you get a Secchi disk reading of six inches or less, the bloom is too dense and the water contains too much nutrient. Try to determine the source of the nutrient. Look to see if livestock manures or field fertilizers may have washed into the pond. If you cannot locate the source, you may have over fertilized the pond. Overfeeding fish can cause excess nitrogen and phosphorus. If this is happening, reduce or stop feeding and be prepared to aerate at night.

How to Fertilize

Phytoplankton have no roots and absorb nitrogen, phosphorus, and other required elements directly from the water. Granular fertilizers should not be broadcast directly into the pond because the granules sink to the bottom. The nutrients then become tied up in bottom sediments and are unavailable for phytoplankton uptake.

If granular fertilizers are used, they should be placed on a platform (e.g., a sheet of plywood) situated 12 inches underwater. (After floating the plywood on the water, place fertilizer on top of it. The platform will then sink to the proper depth.) Place one platform for every five acres of pond surface water. Locate the platform in an area of the pond which receives good wind and wave action to circulate the water. Granules placed on the platform will slowly dissolve and promote a bloom.

If you are using a liquid fertilizer, you must dilute it with water. If liquid fertilizer is undiluted, it will sink to the bottom and be trapped by sediments. Once diluted, liquid fertilizer can be sprayed or splashed into the pond. Apply the fertilizer evenly over as much of the pond surface as possible.

Do not fertilize ponds earlier than March 21 or before water temperatures have reached a minimum of 60° F. Fertilization should stimulate a phytoplankton bloom within two weeks. If a bloom does not appear, fertilize the pond again and continue fertilizing at two-week intervals. Do not fertilize more than 3 times. After a bloom has developed, fertilize the pond as necessary (Secchi disk guide, Table 2) to maintain it. Continue managing your phytoplankton until September 21 or until water temperatures have dropped to 60° F.

Fertilization is ineffective and should not be attempted in "flushing" ponds that have problems with flooding, large overflows, or flow-throughs because they rapidly lose fertilizer. Some ponds will flush many times in winter and early spring, but respond well to fertilization during late spring, summer, and fall.

Muddy ponds (visibility of 12 inches or less) do not usually respond to fertilization. Because of the shading effect, it is difficult to establish phytoplankton blooms in murky water. These ponds are unproductive and receives little photosynthetically produced oxygen. Contact your county Extension office for information about clearing muddy water.

Do not fertilize ponds with an aquatic weed problem because the fertilizer stimulates weed growth only. The nutrients are absorbed by unwanted vegetation, not by phytoplankton. You must control the weeds first. Establishing a fertilization program before weeds appear is one of the best methods to prevent weeds from becoming established. A good phytoplankton bloom can shade out weeds and compete for essential nutrients.

Species Selection and Stocking

The choice of fish to be stocked depends on the pond owner's goals. The largemouth bass and bluegill sunfish combination is the most common strategy for stocking ponds for recreational fishing in South Carolina. The beauty of the bass-bluegill system is its simplicity. In a well-fertilized pond, zooplankton and insect larvae will be plentiful enough to supply food for young bass and all sizes of bluegill. Bluegill grow rapidly and reproduce repeatedly throughout the spring and summer. The bluegill provide bass with an abundant food supply (forage). With proper harvest techniques, the bass will grow rapidly and prevent bluegill from overcrowding the pond. Several large bluegill will survive to reproduce and sustain good bluegill populations.

Channel catfish can be added to a bass-bluegill pond. However, catfish will compete with bass and bluegill for natural foods and lower the number of bass and bluegill caught. Table 3 gives recommended stocking rates for bass, bluegill, and catfish in new or renovated ponds. Blue catfish may be stocked instead of channel catfish. Blue catfish are better predators than channel catfish and will compete with bass for bluegill.

Fish can be obtained for new or renovated ponds from the SCDNR. Contact your local fisheries biologists or conservation officer for more information. Private hatcheries also sell fish and may offer varieties or hybrids selected for rapid growth. Contact your county Extension office for a list of live fish suppliers.

Bluegill should be stocked in early autumn (September) to make sure they have grown and matured enough to spawn in the spring. Bass should be stocked the following May or June so they can grow rapidly by feeding on young bluegill. This ensures that ample forage is available for bass because bluegill spawn three or four times between spring and

fall. After the first season, bass should average one-quarter to one-half pound and can approach two pounds if forage is plentiful. Catfish may be stocked in the fall or spring. When stocking catfish with bass, make sure the catfish are as big as the bass being stocked.

Alternative Stocking Strategies

It is difficult to manage bass-bluegill populations in ponds less than one-half acre in size. These ponds should be stocked with catfish or other species. Catfish are good fighters when hooked and are excellent table fare. Stock 200 to 500 catfish per acre. At this level you should offer feed to the fish. If stocked alone, catfish may reproduce, and the pond can become overpopulated. Try to prevent spawning activity. Catfish are cavity spawners, and reproduction can be prevented by:

1) removing all stumps, rock piles, etc. from the pond;
2) not allowing muskrats or beavers to colonize the pond (catfish will spawn in the burrows); and
3) not placing containers (e.g., tires or milk cans) in the pond that might be used for breeding.

Bass stocked at about 20 to 30 per acre can also help control catfish spawns. Other fish with potential for use in small ponds include blue catfish, redear sunfish, hybrid bluegill, threadfin shad, golden shiners, and fathead minnows. Species which should not be stocked into farm ponds include crappie, gizzard shad, bullhead catfish, and flathead catfish. These species rapidly overcrowd ponds and may reduce populations of desirable fish species.

Crappie are popular sport fish but are not desirable for small ponds (less than 50 acres). It takes 3 years for a crappie to reach a weight of one-half pound. A young, half-pound female crappie can produce 50,000 eggs in a single spawn. Just a few successful spawns during one season will overcrowd a pond with young crappie. When this group of young fish matures, they consume all available food. These young fish stop growing and become stunted. Young crappie also compete directly with young bass and bluegills for food. Large crappie will then feed on small bass and bluegill. It is virtually impossible to manage bass and crappie populations together in farm ponds. The end result is poor fishing for all species.

Redear sunfish (also known as "shellcrackers" because they eat snails) can be stocked with bass and bluegill. Redear sunfish grow larger than bluegill and are excellent sport fish. Shellcrackers are not as prolific as bluegill and do not provide sufficient spawns for bass forage. If you want redear sunfish, stock 20 to 25% redear in place of bluegill (for example, stock 300 bluegill and 100 redear per acre).

Many pond owners like to stock hybrid bluegill because, if they are fed (they can be trained to accept commercial fish feed), they grow rapidly and provide excellent angling. Hybrid bluegill are not sterile like most hybrids. Most of the fish are males, but if females are present, they will reproduce. Reproduction will lead to overpopulated ponds; therefore, predatory fish (bass) should be stocked at 20 to 30 fish per acre to feed on young hybrid bluegill. This combination works best for ponds ½ acre or less.

Table 3. Suggested bass-bream-catfish stocking rate for new or renovated ponds larger than ½ acre.

Species	Fertilized	Number stocked/acre
bass	yes	100
	no	50
bream	yes	1,000
	no	500
catfish	yes	50 - 100
	no	25 - 50

Some pond owners like to stock fathead minnows (1,000 per acre) as a forage fish in channel catfish ponds. These minnows are quickly eliminated if stocked with bass.

In some ponds if the mountain regions of South Carolina rainbow trout will survive in ponds during late autumn and winter. They should be stocked when water temperatures are below 65° F (usually mid to late October). Fingerlings (7-9 inches long) feed on insect larvae, small sunfish, or minnows, and they grow rapidly. Trout readily accept commercial feeds and may reach one pound by April if offered a trout chow. Rainbow trout die when water temperatures reach 70-72° F in April or May.

Harvest and Record Keeping

Ponds should not be fished for one year following stocking. After the first season, bass are often easy to catch. The most common problem in small ponds is removing too many bass. To maintain good fishing, you must carefully control how many pounds of fish are removed each year.

When bass are over harvested, the pond becomes overpopulated with stunted bluegill. If this happens, it is difficult to restore the balance of predator (bass) and prey (bluegill) in the pond. It may be necessary to poison the fish and start again. As a general rule, fertile ponds can sustain an annual harvest of 25-35 pounds of bass per acre. If the pond is infertile, you should not remove more than 10-15 pounds of bass per acre. Do not begin bass fishing in a new pond before bass spawn in the spring, when the water is above 60° F. By practicing catch and release with the bass, you can enjoy successful angling more often. Bluegill should be harvested also. A good general rule is to remove 10-15 bluegill for each bass taken or four pounds of bluegill for each pound of bass.

Catfish may be removed when they reach a size that satisfies the pond owner. Catfish must be stocked periodically to replace individuals that have been removed. Catfish spawns do not usually survive when bass and bluegills are present in a pond. Large catfish fingerlings (8 inches

or longer) should be stocked into ponds with established bass bluegill populations to minimize bass eating small catfish.

Evaluation of Pond Balance

Ponds should be checked every 1 to 2 years to ensure that fish populations are in balance. Contact your local district fisheries biologist with the SCDNR for assistance. Pond balance can be evaluated from catch records and seine data. When using catch records, do not rely on your memory. Be sure to keep records about the number, species, and size of each fish caught.

Balance can also be checked with a 10 or 15 foot minnow seine. The best time to seine the pond is early summer. Try to seine several shallow areas of the pond. Record the size, number, and species of fish caught in the seine. If you catch both young bass and recently hatched bluegill fry in the seine, the pond is most likely balanced. The pond is out of balance when no young bass or bluegill fry but many intermediate-size bluegill (4 to 5 inches long) are caught in the seine. If large numbers of undesirable fish species are caught, it is time to poison the pond and start over.

Weed Control

Aquatic weeds are a common problem in farm ponds. Rooted aquatic vegetation furnishes habitat for some small aquatic animals and increases the food available to the fish. Vegetation also provides small fish with cover to hide from predators. However, if left unchecked, weeds can take over the entire pond and remove the nutrients required for phytoplankton production.

Aquatic weeds can be controlled using physical, chemical, or biological means. Physical control of plants (hand removal) like cattails is practical when they first appear. Woody vegetation along dams can be successfully controlled by hand.

Another option for aquatic weed control is to use herbicides (chemical control). However, many herbicides are not approved for aquatic use. The weeds in question must be accurately identified. Another problem associated with the use of herbicides is oxygen depletion. Oxygen depletions often occur after herbicides have been applied during hot weather in ponds with heavy weed overgrowth. When considering herbicide control, check with your county Extension office, a fisheries biologist, or an aquaculture specialist for plant identification and treatment recommendations. Whenever applying chemicals, be sure to protect yourself and others by carefully following the label instructions.

One of the simplest and most economical long term methods of controlling rooted aquatic vegetation in new or recently treated ponds is to stock grass carp. The grass carp or "white amur" is an Asian carp brought into the U.S. to control aquatic weeds. These fish are primarily plant eaters once they reach a length of 10 inches. They do not stir up bottom mud like common carp or disturb the nests of other fish. During warm weather, grass carp can eat 30-40% of their body weight in weeds daily.

Grass carp prefer flowing water and will swim over a pond spillway if given the opportunity. An escape barrier can be placed across the spillway to prevent this from happening. Only sterile, triploid grass carp may be stocked in South Carolina. A list of certified triploid grass carp suppliers and information about building an escape barrier can be obtained from the SCDNR or the Clemson University Cooperative Extension Service.

The number of triploid grass carp that should be stocked depends on which weeds are present and how bad the problem is (see Table 4 for grass carp stocking rates). If large springs flow into your pond (this keeps the water cool), you might have to stock additional grass carp for effective weed control. If the pond contains large bass, you must stock 8-inch or longer grass carp fingerlings. Bass will eat the small grass carp.

A permit from SCDNR is required to stock grass carp in South Carolina.

For more information on aquatic weed control refer to the "2009 Pest Management Handbook" which is published by Clemson University's Cooperative Extension Service. For an excellent site on aquatic plant management, go to http://aquaplant. tamu/edu.

Potential Problems

As already mentioned, most pond problems are related to improper management. One final problem which landowners should be aware of is fish kills related to pond "turnover." Pond turnover is related to **pond stratification** or layering. Stratification occurs when surface water warms faster than deep water. The warm layer is lighter and does not mix with the cool, deep water. The cool water near the bottom becomes stagnant and does not circulate. In the deep, cool water oxygen becomes depleted and toxic compounds may be produced by bacteria and decaying organic matter. A **turnover** occurs when the upper layer cools quickly and mixes with the stagnant layer. The resultant mixture may not contain enough oxygen to support fish. Turnovers usually take place after a cold, heavy rain or the sudden passage of a cold front. Immediate or preventive aeration may save the fish. Fish kills can also be caused by oxygen depletions resulting from phytoplankton bloom die offs or decomposing vegetation killed by herbicide applications.

Enhancement Techniques

In addition to managing a pond correctly, several other techniques can improve farm pond fishing. Some of these techniques include: 1)

Table 4. Stocking rates for triploid grass carp.

Weed Evaluation	Grass carp stocked/acre
new pond or minor weed problem	5
moderate weed problem (10-20% coverage)	12 to 15
severe weed problem or spring few pond	20 plus

adding fish shelters/habitat, 2) supplemental feeding, 3) checking and adjusting water levels, and 4) aeration.

Fish shelters. What did you do with last year's Christmas tree? When you are renovating old pastures, where do you pile up those eastern red cedar trees you removed? Did you ever think of anchoring them to the bottom of your pond to act as a refuge for fish? Artificial reefs or fish shelters allow young fish to escape predation. Besides old Christmas trees, eastern red cedar, or brush, other good fish sanctuaries include stakes driven into the bottom of a pond (stake bed), rock piles, and tire reefs. These structures should be placed no deeper than two to six feet below the water. Do not place more than three structures per acre.

A good way to increase fish reproduction is to place nesting structures in the pond. Fish spawns can be encouraged by furnishing breeding areas throughout the pond. If your pond has a silty bottom, spawning beds are necessary for successful fish reproduction. Spawning beds allow you to observe the reproductive success of your fish. Spawning beds are made by building a frame or box around 4 to 6 inches of sand and gravel. Place beds at several locations around the shoreline in 2 to 5 feet of water.

Supplemental feeding. Providing supplemental, commercial fish feed is a way to increase the growth of sunfish and catfish. Bass do not feed on artificial feeds but do benefit from the increase in small sunfish which they eat. If a pond owner decides to offer supplemental feed, offer the feed in the same area and at the same time each day. Do not overfeed fish. A good general rule is to supply what the fish will eat in 10 to 15 minutes. Do not feed the fish more than 15 pounds of feed per acre each day. Fish can be fed from April through October. Winter feeding is not required but will improve bluegill growth and reproduction. If feeding is continued during the winter months, use a feed that sinks to the bottom of the pond, and do not offer more than three pounds of feed per acre daily.

Adjusting water levels. Another good way to control aquatic weeds, while improving bass growth and reducing sunfish populations, is to install a drain in the pond. SCDNR, NRCS or the Clemson University Cooperative Extension Service has more information on drains. Ponds with drains have distinct management advantages. In relatively deep ponds, the water can be drawn down 2 to 3 feet in late fall and maintained at that level throughout the winter. Fall drawdown helps control aquatic weeds as a result of freezing and drying on areas of exposed pond bottom. Lowered water levels concentrate fish which increases forage availability to bass. Bass growth is improved and sunfish populations are reduced. Ponds should be allowed to refill during March and April.

Good management takes time and effort. However, the rewards are good food and lasting outdoor recreation for family and friends.

There are various fact sheets on pond management and aquatic weed control available on Clemson University's Home and Garden Information Center. Visit the web site at www.clemson.edu/extension/hgic/.