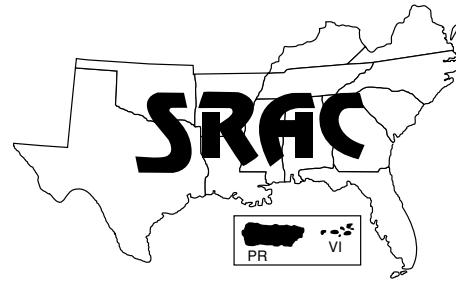


**Southern
Regional
Aquaculture
Center**



May 2002
Revision

Construction of Levee Ponds for Commercial Catfish Production

Jim Steeby and Jimmy Avery*

Proper design and construction of ponds is critical to the success of a commercial catfish operation. Well-designed ponds, constructed on soil with proper clay content and adequate water supply, have a useful life of at least 10 years. Contact your area USDA-Natural Resources Conservation Service to have your site evaluated for vertical clay and sand content. Ponds constructed without proper planning may not hold water or have adequate access, and may have persistent weed problems, be difficult to harvest, and be difficult to drain completely.

Information in this publication is based primarily on pond construction experience in the Delta region of Mississippi, Arkansas and Louisiana. Please refer to SRAC publication no. 102, "Watershed Fish Production Ponds," for information about constructing ponds in rolling terrain.

Pond morphology

Commercial catfish ponds are being built deeper than previously recommended. Research indicates and producer opinion confirms that deeper ponds have longer life expectancy and allow greater water conservation. Where possible, ponds should be built to contain an average of 5.5 to 6 feet of water depth. This requires that average total pond depth with freeboard be 7 to 7.5 feet.

Minimum water depth in the shallow area should be 3.5 feet with a maximum depth near the drain of 8 feet. Ponds should have a minimum average water depth of 3 feet at all times. A bottom slope of 0.2 to 0.3 feet per 100 linear feet along the long axis of the pond is recommended for adequate drainage.

In recent years, the average size of newly constructed, commercial catfish ponds has declined to 8 to 12 acres. As older, larger ponds (18 to 25 acres) have been renovated, producers have divided them into smaller production units. Fish farmers report that the additional

costs associated with building smaller ponds are more than offset by improved feeding efficiencies and ease of management. A 12-acre land unit should yield 10 acres of water depending on levee top width and the slope selected for the inside levee.

Topography and the planned use for the pond will determine pond size. Ponds used to produce fry and fingerlings are typically smaller than ponds used for food fish production. A typical layout of commercial catfish ponds is shown in Figure 1.

Pond shape is determined by the boundaries of the production unit and the access to drainage. Ponds are typically rectangular and have a 2:1 to 3:1 ratio of length to width. While square ponds are cheaper to construct, rectangular ponds have the following advantages: longer levee length for feeding; lower electrical and piping costs; and shorter seines needed for harvesting (Fig. 1). A pond with a dimension of 500 x 1000 feet will contain approximately 10 acres of water.

*Mississippi State University

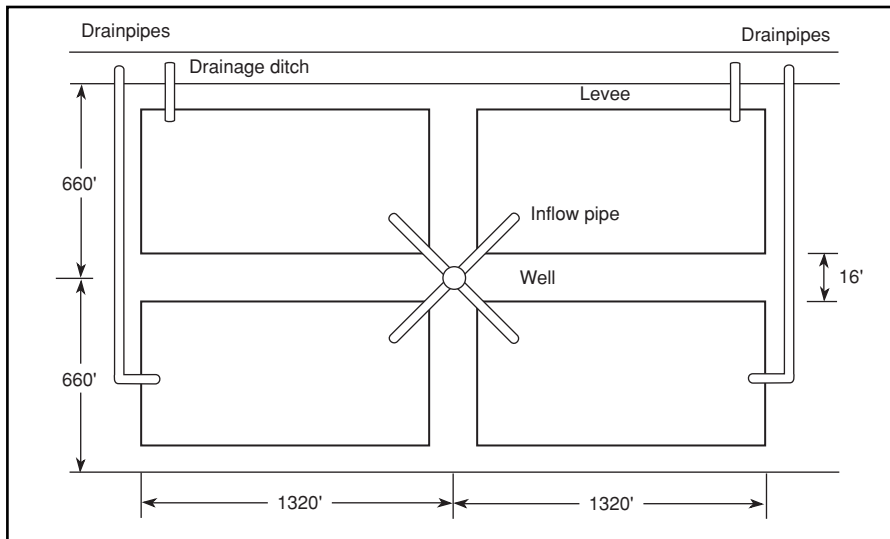


Figure 1. Layout of a typical levee-type catfish pond.

Ponds should be as regularly shaped as possible. Triangular ponds or ponds with lots of curvature in the levees can be difficult to harvest. These ponds are also more expensive to construct on a land to water-acre basis. Use remaining small or irregularly shaped parcels of land for feed bins or equipment storage where possible.

The long axis of rectangular ponds should be parallel to prevailing winds during the peak production period of April through October. Thus, ponds in the southeastern U.S. should be constructed with the long axis running from west-southwest to east-northeast. A north-south orientation of the long axis should be avoided to minimize the erosion caused by winter winds.

Design of levees

Interior levees should have a minimum top width of 16 feet (20 feet is preferred so two vehicles can pass safely). Levees narrower than 16 feet may become difficult to traverse and be unusable in 3 to 5 years if there is even the smallest amount of erosion. Narrow levees hinder management and are dangerous at night and when wet.

Main access levees should have a minimum top width of 20 feet; 25 feet is preferred. Main levees

must be wider to accommodate fixed equipment such as wells, generators, aerators and electrical panel boxes while permitting passage of feed delivery and hauling trucks. Main levees should be graveled for all-weather access. Harvesting, feeding and bird control are often carried out during wet conditions, making gravel essential on at least one side of each pond.

Freeboard is the height of the levee above the normal water level. A 1.5-foot freeboard height is recommended (USDA Natural Resources Conservation Service) for a pond 600 to 1,300 feet long. One foot of freeboard is adequate if ponds are less than 600 feet long. Excessive freeboard (more than 2 feet) makes seining and placement of emergency aeration equipment more difficult.

Slope is expressed as the horizontal distance (in feet) that results in a 1-foot change in height. Hence, a

3:1 slope extends out 3 feet horizontally for each foot of height, and a 4:1 slope extends 4 feet horizontally for each foot of height (Fig. 2). The slope selected by the pond owner will affect construction costs. Greater slope may decrease erosion but will also increase construction costs. For most soils, an outside levee slope of 3:1 is preferred. Inside slope for commercial ponds typically ranges from 3:1 to 4:1 depending on owner preference. Slope greater than 4:1 should be avoided, as construction costs are excessive and there are likely to be more weed problems.

Drainage

A perimeter drainage system should be constructed to receive effluents and to prevent water from standing outside levees. The existing drainage system might be modified, or a new system constructed. Earth removed during construction of the drainage ditches can be used as fill for levees.

Drains are most often installed after the levee is constructed by trenching through the levee with a backhoe. This ensures proper placement of the drain and minimizes the risk of settling, which can hinder the complete draining of the pond. A single 10-inch-diameter drain of heavy gauge, coated metal or PVC pipe is adequate to maintain water level and drain a commercial pond. Because most soils have high clay content and most levees are relatively low, anti-seep collars are not usually included on the drainpipe.

The drain should extend into the pond and past the outside levee

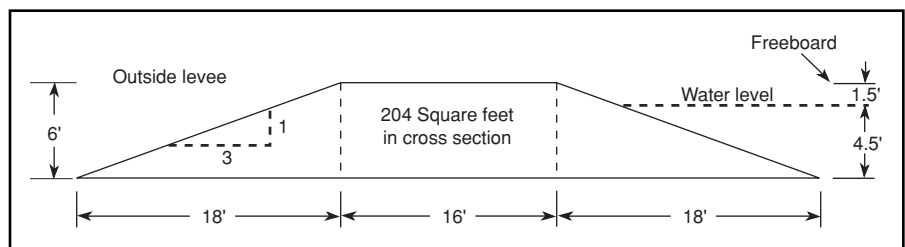


Figure 2. Cross-section of a typical levee for a commercial catfish pond. Each linear foot of this levee contains 7.6 cubic feet of fill material.

toe by at least 5 feet. A 1-inch drop in the pipe to the levee toe will ensure complete drainage of the pipe when the pond is dry. The inside (pond side) drain end is capped with an expanded metal screen (0.5-inch mesh) 3 to 4 feet long to keep fish from entering the drain. If the pipe does not extend properly outside the pond, severe levee erosion is likely to occur when overflow or drain water is released. The outside end is fitted with a "T" standpipe to set the desired pond level and capped at the end with an alfalfa valve (Fig. 3). The length of the plastic terminal sleeve (or "jam pipe or riser") can be altered to adjust the water level in the pond. Other drain types such as "swivel pipes" and concrete "monks" can be installed in commercial ponds but are not recommended because they cost more and have limited usefulness. The area immediately surrounding the interior drain (25-foot-radius) should be slightly deeper (3 to 4 inches) than the rest of the pond so that the pond drains fully. Any fish remaining at drawdown will be concentrated in this area.



Figure 3. Outside drain fitted with a "T-stand pipe" and alfalfa valve.

Site preparation and construction

All vegetation, roots and stumps must be removed before levees are constructed. The top 2 to 3 inches of surface soil can be removed and reserved for placement on outside levee slopes so that any recent pesticide residues are excluded from the pond. This soil will also be more conducive to establishing vegetative cover.

Dirt pans are the primary implements recommended for commercial levee construction. They cost less to use and compact the soil better than other implements. Dirt pans lay down a thin layer of soil with each pass and pack the previously applied soil layer. Bulldozers are the primary implements used in pond renovation (see SRAC publication no. 104). For proper compaction, soil moisture content should be 12 to 15 percent. Moisture levels higher or lower than this can make soil compaction difficult. Levees built from heavy clay soils (more than 30 percent) following these guidelines should have a useful life of 10 years or more.

Where groundwater is relatively abundant, wells are the preferred water source because groundwater is free of undesirable fish and contaminants. A well output of 1,000 gallons per minute is considered adequate to fill and maintain 40 water acres (25 gallons per minute per water acre). The well can be drilled either before or after construction. Well placement should be as close as possible to minimize the amount of pipe required. Lengthy pipe installations cost more to construct and repair, and yield less water

Table 1. End areas in square feet of embankment sections for different side slopes and top widths.

Fill height (ft.)	Side slope ratio				Top width (ft.)			
	Outside pondside	3:1	3:1	3:1	16	20	25	30
		3:1	3:5	4:1				
4.0		48	52	56	64	80	100	120
4.5		61	66	71	72	90	113	135
5.0		75	81	88	80	100	125	150
5.5		91	98	106	88	110	138	165
6.0		108	117	126	96	120	150	180
6.5		127	137	148	104	130	163	195
7.0		147	159	172	112	140	175	210
7.5		169	183	197	120	150	188	225
8.0		192	208	224	128	160	200	240

To calculate the volume of soil needed, add side slope area to top width area and multiply this total by levee length. The outcome is in cubic feet. To convert cubic feet to cubic yards divide by 27.

Example: With fill height of 7 feet and 3:1, 4:1 slopes with levee width 20 feet and 500 feet of levee
 $(172 + 140) \times 500/27 = 5.778$ cubic yards

Add 10% to allow for shrinkage and settling.

because of frictional forces. The distance from the wellhead to the farthest discharge point should be less than 1,500 feet in any direction. Well pipes are buried in the ground to permit traffic on levee tops. Filling ponds by connecting pipes pond to pond is not recommended because it takes longer to fill connected ponds and disease and trash fish can be transferred from one pond to another.

As soon as pond construction is completed, a vegetative cover should be established on the levees to control erosion. Winter annuals such as rye or wheat or

perennial forages such as bermudagrass make good cover and will exclude most volunteer grasses and weeds that provide poor coverage. If construction is completed and wheat or rye grass planted in the fall, it should be replaced with bermudagrass or another effective low cover in the spring. Establishing proper cover is cost-effective because it prevents excessive erosion, reduces mowing costs, and allows all-weather access to ponds. For information on the best ground covers for your location, consult your state Extension service Web site for publications or contact your county Extension agent.

References

- Ponds—Planning Design, Construction*
United States Department of Agriculture/Natural Resources Conservation Service
Agriculture Handbook
Number 50, Revised 1997
U.S. Department of Agriculture
Washington, D.C. 20250
- Commercial Fishponds*
United States Department of Agriculture/Natural Resources Conservation Service
Conservation Practice Standard
Field Office Technical Guide,
Section IV, Revised 2000
U.S. Department of Agriculture
Washington, D.C. 20250

SRAC fact sheets are reviewed annually by the Publications, Videos and Computer Software Steering Committee. Fact sheets are revised as new knowledge becomes available. Fact sheets that have not been revised are considered to reflect the current state of knowledge.



The work reported in this publication was supported in part by the Southern Regional Aquaculture Center through Grant No. 2001-38500-10307 from the United States Department of Agriculture, Cooperative State Research, Education, and Extension Service.