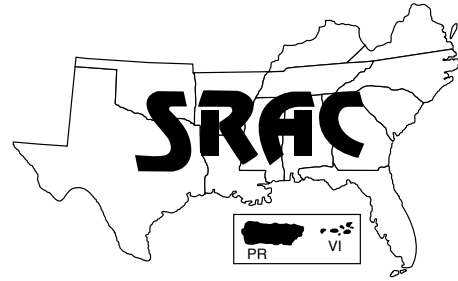


**Southern
Regional
Aquaculture
Center**



October 1997
Revision

Construction of Levee-type Ponds for Fish Production

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Construction of ponds for the commercial production of aquatic animals is one of the most expensive and important aspects in developing a fish farm. Unless careful consideration is given to the design and the cost of pond construction, you may find the layout is not suitable for the species of fish you want to raise, and the cost of building is such that it is impossible to make a profit.

Obviously, prior to starting construction you must make sure the site selected is suitable for the facility planned; i.e., that it is not subject to flooding, can be easily drained, adequate water is available, and it does not have high levels of chemical residues in the soil. Another important consideration is the topography of the site. Less dirt has to be moved when levee-type ponds are constructed on flat land than on hilly or rolling land, resulting in lower construction costs.

Size

Most commercial catfish ponds in the Mississippi Delta are built on a 20-acre land unit, which yields a surface area of about 17.5 acres of water depending on the slope of the inside (wet) levee, the top width of the levee, and the height of the levee above the normal water level. The height of the levee top above water level is often referred to as freeboard. The 20-acre size pond is a compromise

between ease of management and cost of construction. A larger pond is much more difficult to manage, and ponds smaller than this are more expensive to construct because more valves and inflow pipes and drainpipes must be used. In addition to costing more to construct, smaller ponds decrease the amount of water area available for fish production. If a 20-acre land unit is made into two 10-acre pond units with 16-foot

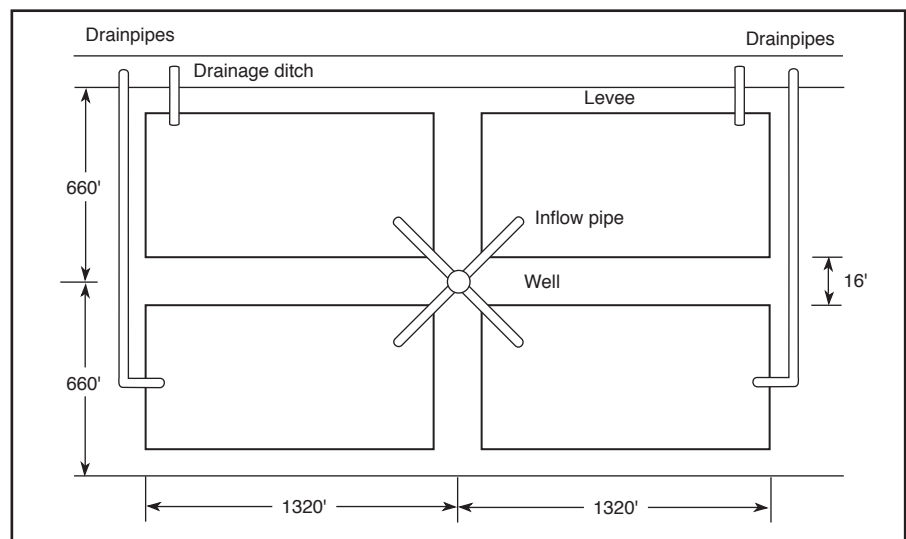


Figure 1. Layout of a typical levee-type catfish pond.

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tops, 3:1 slopes, and 1.5 feet of freeboard, rather than into one 20-acre pond unit, about 0.34 surface acres of water will be lost due to the increased amount of levee needed. If you assume an average annual production of 6,000 pounds of catfish, this loss of water due to the increased amount of levees equals a loss of about 2,040 pounds of catfish production annually per 20-acre pond unit.

Decisions on actual pond size will depend on what you want to raise, the topography of the land, and the amount of land available for pond construction. Before deciding on pond size, look at the cost of building several different size ponds, and go with the size that is most economical and consistent with your production goals and degree of management planned. A typical layout of levee-type catfish ponds is shown in Figure 1.

Shape

Pond shape is largely determined by the topography and by property lines. Most commercial levee-type fish ponds are rectangular because of the greater ease and economics in harvesting and feeding, although square ponds are cheaper to build. A square 20-acre pond requires 3,596 feet of levee, whereas a rectangular 20-acre pond that is 660 feet by 1,320 feet requires 3,822 linear feet of levee, a difference of 226 feet. A rectangular 10-acre pond (467' x 933') requires 2,729 linear feet of levee, whereas a square 10-acre pond (660' x 660') requires 2,569 feet of levee, a difference of 160 feet.

Ponds with a curving, irregular shape are not only very difficult to harvest unless drained, they are extremely difficult to manage with respect to water quality. You should never consider building an irregularly shaped pond for commercial fish production unless there is some compelling reason. Even then you should carefully weigh the advantages

and disadvantages with regard to costs and management before making a decision.

Levee width

Levees should be at least 16 feet wide at the top, and the main levees where the wells are located should have a 20-foot top width to allow an easier flow of traffic for feeding, harvesting, and water quality management.

Levees with top widths less than 16 feet require more maintenance than do those with top widths of 16 feet or greater. Narrow levees also are a greater hazard to employees and equipment in wet weather.

If the soil type is such that the levees become impassable in wet weather except to 4-wheel drive vehicles, at least two sides of each pond should be graveled to permit all-weather access for feeding, harvesting, disease treatment, and water quality management.

Freeboard and depth

Freeboard is the height of the levee above the normal water level. The amount of freeboard should not exceed 2 feet nor be less than 1 foot. Levees with a freeboard in excess of 2 feet are expensive to build. Excess freeboard makes it difficult to get equipment into and out of the pond. Levees with a freeboard of less than 1 foot are subject to erosion, thus increasing maintenance costs.

Depth of the pond is important because of management implications. The depth of the pond at

the toe of the slope at the shallow end should never be less than 2.5 feet nor greater than 3.5 feet. At the deep end of the pond, the maximum depth at the toe of the slope should not exceed 6 feet, with a 5-foot depth preferred. The pond bottom must be flat, free of all roots, stumps, and debris that might interfere with seining, and slope from the shallow end to the deep end at a rate of 0.1 to 0.2 feet per 100 linear feet along the long axis of the pond.

Slope of levees

Slope is expressed as a ratio of the horizontal distance in feet for each 1 foot of height; e.g., a 3:1 slope extends out 3 feet horizontally for each foot in height, and a 6:1 slope extends 6 feet horizontally for each foot of height.

The actual slope of the levees will depend on the type of soil at the pond site, but for most soil types a 3:1 slope is satisfactory if properly compacted. Increasing the slope to a 4:1 or 5:1 will substantially increase the amount of dirt required for the levees, hence the cost of construction is increased. For example, a levee 6 feet high, with a 16-foot top width and 3:1 slope contains 7.6 cubic yards of dirt per linear foot, whereas a levee with the same dimensions except for a 4:1 slope requires 8.9 cubic yards of dirt, and a levee with 5:1 slope needs 10 cubic yards of dirt per linear foot. The cross-section of a typical levee for a catfish pond is shown in Figure 2.

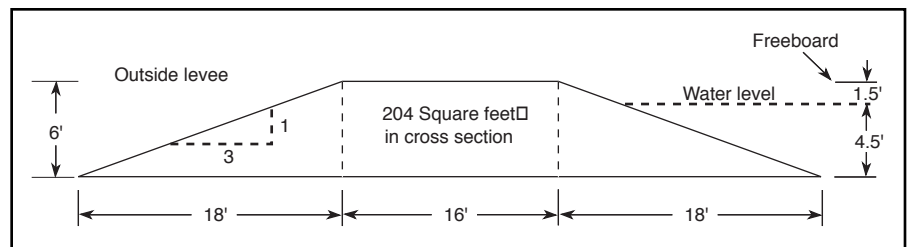


Figure 2. Cross-section of a typical levee for a commercial catfish pond. Each linear foot of this levee contains 7.6 cubic feet of fill material.

Orientation

The direction in which the long axis of the pond is oriented depends to a large extent on the topography of the site and the property lines. There are arguments as to whether ponds should be oriented with the long axis parallel or at right angles to the prevailing winds. Levees of ponds with the long axis parallel to the prevailing winds are subject to erosion because of increased wave action, but the ponds are better aerated because of this increased wave action. Ponds oriented at right angles are subject to less levee erosion and are not as well aerated by winds.

Site preparation and construction

All existing vegetation, roots, stumps, and topsoil must be removed from the site prior to starting levee construction to allow a good bond between the foundation soil and the fill material. After completion of the levee, several inches of topsoil are put back on the top and outside slopes so a vegetative cover can be established quickly.

Because of their speed, self-loading pans are the most efficient equipment to build pond levees. They also give the best compaction of the fill material when complete wheel track coverage is made over each layer of fill placed in the levee. For proper compaction the soil must have at least 12 to 15 percent moisture. If the soil is dry during construction, each layer of fill dirt placed on the levee must be wetted before compaction. Laser-controlled pans increase the accuracy and speed of the cuts and fills. Bulldozers can be used to build pond levees but they do not give good compaction. If bulldozers are used, it is best to use a sheepsfoot roller to give complete coverage over each layer of fill.

The area in the levee where the drain is located is left open during construction for drainage of any storm water. As soon as the pond bottom and drain site are excavated to grade, the drainpipe is installed.

The PVC or steel drainpipe, of appropriate diameter, should be installed as soon as the pond bottom is to grade. A small, sloped ditch, about 1/3 of the diameter of the drainpipe, is dug to give uniform support for the pipe. Fill material is placed around the side and over the top of the drain to a distance of at least 1 foot and is hand compacted. This fill material **must be moist** during hand compaction to insure a watertight seal around the drainpipe. The hand-compacted fill over the drain gives protection from heavy equipment during completion of the levee construction.

Drains

Ponds must be sited and constructed so they can be drained by gravity flow. Obviously, the lowest part of the pond must be higher than the ditch into which it is to be drained. The pond bottom must be flat and slope from the shallow to the deep end with a slope of 0.1 to 0.2 feet per linear 100 feet. A flat, sloping bottom is necessary for harvesting and draining. **Do not build a harvest basin inside or outside the pond.** Inside or outside harvest basins do have a place in the production of certain types of fish although they are expensive to construct. In the early years of commercial catfish production, harvest basins were routinely built but were quickly discarded because of problems and expense associated with them.

There are several types of drain structures used in levee-type catfish production ponds. The best type of drain structure to use is the one that most closely meets your needs based on your situa-

tion; i.e., the pond design selected and estimated cost.

The so-called **inside swivel drain** or modified Canfield outlet is the most common drain used in levee-type ponds. It is located at the lowest part of the pond. The depth of the water in the pond is determined by the length of the upright drainpipe, and water level is adjusted by pivoting the upright drain up or down on its swivel joint. It must be held securely in position to prevent unplanned drainage. This can be done with a chain from the end of the upright drain to a post on the bank. Heavily grease the swivel joints to allow easy movement. Maintenance of the swivel joints can be a problem since work has to be done under water or when the pond is drained.

Many farmers who raise catfish in levee-type ponds have gone to the outside drain. The drainpipe is laid through the levee at the lowest point in the pond with the inside end extending at least 5 to 10 feet out from the toe of the slope to prevent clogging by dirt sloughing from the levee. This inside end is screened to prevent loss of fish.

The outside end of the drainpipe should extend 5 feet past the toe of the slope to prevent excess erosion of the levee during draining. The outside end of the pipe is fitted with a "T" and a standpipe of the height necessary to maintain the desired normal water level in the pond. The end of the "T" is fitted with an alfalfa valve for water level manipulation and complete draining if needed.

Another method is to have the outside standpipe 24 inches high, rather than the height of the normal water level in the pond, and fitted with an alfalfa valve. The end of the "T" is capped. During rain the alfalfa valve is partially opened to remove excess water. The system permits rapid draining of 3 to 4 feet of water with

slight danger of wild fish entering the pond through the drainpipe. The pond can be completely drained by removing the cap at the end of the "T".

It is extremely important to have the discharge end of the drainpipe at least 24 inches above the surface of the water in the drainage ditch. By doing this, wild fish can be prevented from entering the pond through the drain.

Size of drain

Size of the drainpipe needed is dictated by the size of the pond constructed and how rapidly you want to drain the pond. Regardless of the pond size, install a drain that will allow the pond to be completely drained in no more than 7 days, and preferably in 5 days.

Design Assistance

Consult your local Natural Resources Conservation Service office for assistance in planning the design of your fish ponds. They are experienced in pond design and can help prevent you from making severe design flaws. They can also help calculate the cubic yards of dirt that must be moved during construction using one of several computer programs.