



# Construction of Levee-type Ponds for Fish Production

Thomas L. Wellborn  
University of Florida

Oklahoma Cooperative Extension Fact Sheets are also available on our website at: <http://osufacts.okstate.edu>

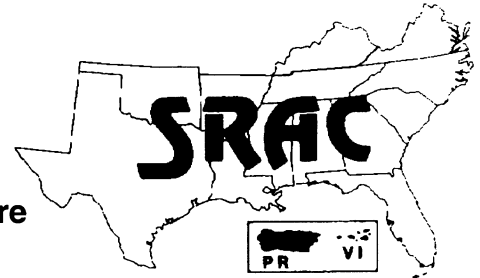
Construction of ponds for the commercial production of aquatic animals is one of the most expensive and important aspects in developing a fish farm. Unless careful consideration is given to the design and the cost of pond construction, you may find the layout is not suitable for the species of fish you 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 gives 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 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 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

Southern  
Regional  
Aquaculture  
Center



is made into two 10-acre pond units with 16-foot 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 4,200 pounds of catfish, this loss of water due to the increased amount of levees equals a loss of about 1,428 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 Fig. 1.

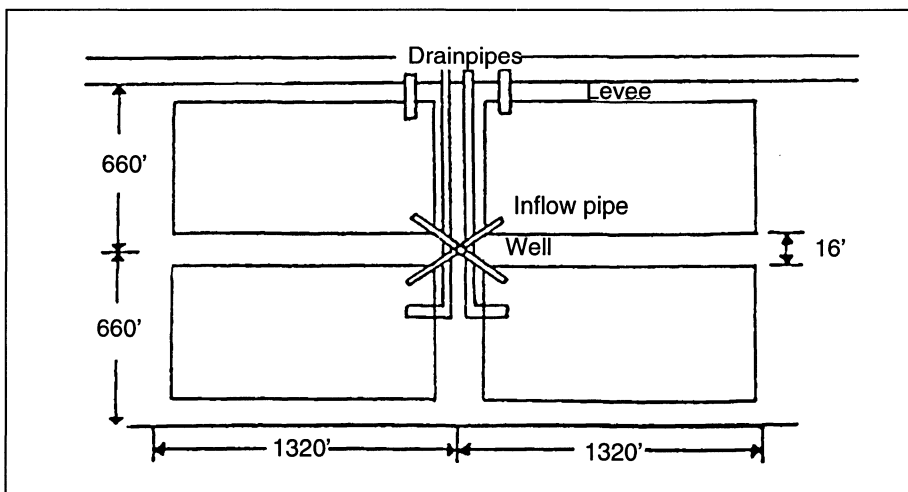


Fig. 1. Layout of a typical levee-type catfish pond.

## 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 one 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 Fig. 2.

## 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

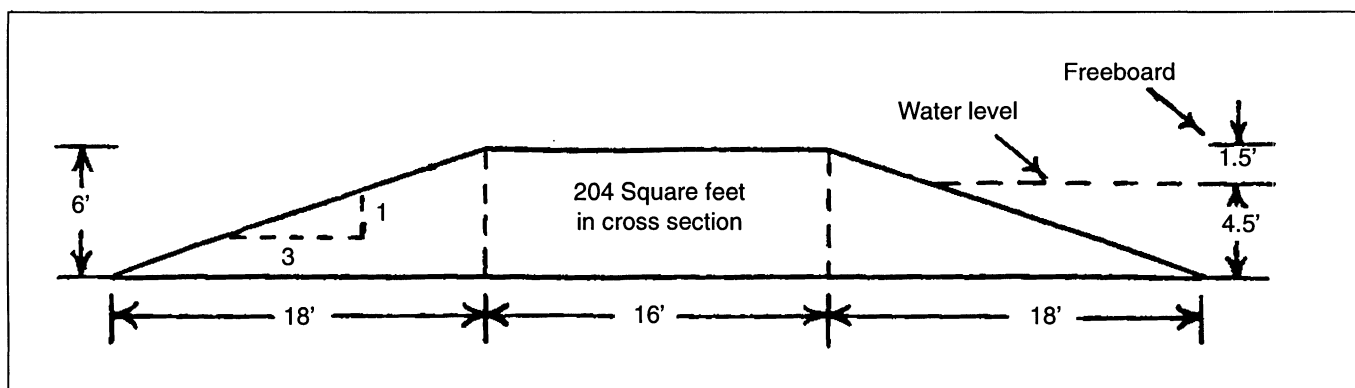


Fig. 2. Cross-section of a typical levee for a commercial catfish pond.

Each linear foot of this levee contains 7.6 cubic feet of fill material.

aerated. There is no research to suggest which is the best way to orient ponds with respect to prevailing 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 sheeps-foot 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 during construction. As soon as the pond bottom and drain site are excavated to grade, the drainpipe is installed.

The PVC drain pipe, 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 drain pipe. The hand compacted fill over the drain gives protection from heavy equipment during the completion of the levee construction.

## Drains

The 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 100 linear 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 situation; 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 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 5-10 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. This system permits rapid draining of 3-4 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 Soil conservation Service technician 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 the microcomputer program Auto Pond.

## **The Oklahoma Cooperative Extension Service**

### ***Bringing the University to You!***

The Cooperative Extension Service is the largest, most successful informal educational organization in the world. It is a nationwide system funded and guided by a partnership of federal, state, and local governments that delivers information to help people help themselves through the land-grant university system.

Extension carries out programs in the broad categories of agriculture, natural resources and environment; family and consumer sciences; 4-H and other youth; and community resource development. Extension staff members live and work among the people they serve to help stimulate and educate Americans to plan ahead and cope with their problems.

Some characteristics of the Cooperative Extension system are:

- The federal, state, and local governments cooperatively share in its financial support and program direction.
- It is administered by the land-grant university as designated by the state legislature through an Extension director.
- Extension programs are nonpolitical, objective, and research-based information.
- It provides practical, problem-oriented education for people of all ages. It is designated to take the knowledge of the university to those persons who do not or cannot participate in the formal classroom instruction of the university.
- It utilizes research from university, government, and other sources to help people make their own decisions.
- More than a million volunteers help multiply the impact of the Extension professional staff.
- It dispenses no funds to the public.
- It is not a regulatory agency, but it does inform people of regulations and of their options in meeting them.
- Local programs are developed and carried out in full recognition of national problems and goals.
- The Extension staff educates people through personal contacts, meetings, demonstrations, and the mass media.
- Extension has the built-in flexibility to adjust its programs and subject matter to meet new needs. Activities shift from year to year as citizen groups and Extension workers close to the problems advise changes.

For more information about aquaculture in Oklahoma, see our OSU county Extension agent or contact Marley D. Beem, Area Extension Aquaculture Specialist, Box 1378, 1630 E. Beverly, Ada, OK 74820 (phone: 405-332-4100).

Oklahoma State University, in compliance with Title VI and VII of the Civil Rights Act of 1964, Executive Order 11246 as amended, Title IX of the Education Amendments of 1972, Americans with Disabilities Act of 1990, and other federal laws and regulations, does not discriminate on the basis of race, color, national origin, gender, age, religion, disability, or status as a veteran in any of its policies, practices, or procedures. This includes but is not limited to admissions, employment, financial aid, and educational services.

Issued in furtherance of Cooperative Extension work, acts of May 8 and June 30, 1914, in cooperation with the U.S. Department of Agriculture, Robert E. Whitson, Director of Cooperative Extension Service, Oklahoma State University, Stillwater, Oklahoma. This publication is printed and issued by Oklahoma State University as authorized by the Vice President, Dean, and Director of the Division of Agricultural Sciences and Natural Resources and has been prepared and distributed at a cost of 20 cents per copy. 0607