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Southern
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Center



Watershed Fish Production Ponds

Site Selection and Construction

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Pond site selection and design may be the most important factors determining aquaculture profitability. Ponds that leak, have irregular bottoms, or suffer from routine water shortages cannot be used to produce commercial crops of fish.

Ideally, levee ponds built on flat land and filled with ground water or surface water are more suitable for commercial fish production. However, most Southeast terrain is rolling and not conducive to this type construction, and water supplies for filling levee ponds are often in short supply or will eventually limit their use. In hilly terrain, pond builders can take advantage of runoff from rainfall on the watershed. Dams are constructed across valleys, to form reservoirs where the runoff water is stored.

Water supplies

Water to fill and maintain watershed ponds usually comes entirely from watershed runoff, although ground water (wells) and surface water

(springs, streams and reservoirs) can be used as supplementary water. Watershed to water surface acreage ratios should be large enough to fill ponds during rainy months but allow them to drop no more than 2 feet during drier months. Watershed to water surface ratios vary from 5 acres of land for each acre of pond in heavy clay soil on open sites to 30 acres or more for each surface acre of pond on porous, wooded sites.

Water quality is affected by the watershed. Waters of low alkalinity generally originate from acid soils. Alkaline water originates from soils with good quantities of limestone. Alkaline water (50 to 300 ppm as CaCO_3) is the most desirable for fish production. Acid pond soils can be neutralized with applications of agricultural limestone.

When a watershed is too small to supply enough water to the pond, an outside source of water (wells, streams or rivers) is needed for filling. Check for state and local regulations, however, before using these sources. When ponds are built in series in a valley, less watershed is needed to maintain a pond. Before harvest,

water can be pumped or drained from one pond to another for storage. This allows ponds to be refilled, using the stored water, immediately after harvest.

Soil characteristics

Good quality soil containing at least 20 percent clay is necessary for building dams and spillways. This includes clay, silty clay and sandy clay soils. Soil should be sampled by frequent borings along a proposed dam site to check for a clay base.

Borings for additional clay sources should be taken in the vicinity of the dam. If removal of clay from the pond bottom uncovers rock formations, sand or gravel areas, it is best to leave the clay in place.

Pond construction in limestone areas can be especially risky because of underlying cracks and sinks, which may cause ponds to leak. In these areas soils should be bored to check for soil quality in the area to be covered by water. Approximately 4 borings per acre are sufficient unless there are soil type variations in the pond bottom.

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Topography

Topography will determine the size and shape of a watershed pond. Generally, steep slopes in V-shaped valleys require larger volume dams per water surface acre than sites with gently sloping hills and wide flat valleys. Steep terrain costs more per pond acre than ponds built in gently rolling terrain.

Ideally, watershed ponds should be less than 10 feet deep at the drain. Deeper ponds must be partially drained for a clean harvest.

Gently sloping topography allows for construction of two-sided and three-sided watershed ponds constructed parallel to hills bordering a creek. Runoff is used as a water source but a dam does not cross a hollow or draw. Objectives in building these ponds are to avoid large, uncontrollable waterways and to make them seinable without draining to harvest.

Other considerations

Sites should be selected so that pipes and valves can be installed to drain the pond completely. Floods from nearby rivers should not overflow the dam and floods within the watershed should not endanger the structure. Information on the 100-year flood potential can be acquired from district offices of the U.S. Soil Conservation Service.

Mark off the waterline of the proposed pond to make sure that water does not encroach on properties owned by others. If the area is classified as a wetland, the U.S. Army Corps of Engineers, and possibly some state agencies, will require a permit before construction begins. Contact your local county Extension agent about other possible restrictions.

Construction of watershed ponds for fish production

Growing and harvesting fish from watershed ponds is more difficult than from levee ponds due to erratic water supplies, irregular bottoms and sides, and excessive depths.

Advantages that watershed ponds have are inexpensive construction, "free" water and less competition for use with other types of agriculture.

Size

Topography generally determines the size pond that can be constructed. Ponds larger than 20 acres are difficult to manage and should be avoided. Sites where very large individual ponds could be built can be divided into smaller ponds built in series.

Marketing strategy also influences size; processors or custom harvesters prefer not to harvest fish from ponds smaller than 5 acres. In contrast, if local markets are targeted for weekly sales, ponds less than 5 acres maybe appropriate.

Dam construction

All trees, brush, roots and topsoil should be removed from the dam area. To prevent seepage, a core must be made in the damsite by digging 3 feet into good quality clay with a bulldozer and/or backhoe. Clay should be backfilled into the trench and compacted in layers 6 to 12 inches thick. As the dam is constructed, the core of the best quality clay should extend from the bottom of the trench to the top of the dam.

The inside and outside slopes of the dam should be 3:1. The width of the top of the dam should be 12 to 16 feet. Since most harvesting operations take place at the dam, the top should be graveled and roads leading to the dam should be maintained for year-round access.

Spillways

An overflow pipe connected to the main drain pipe in a "T" should handle small flows of excess water. The top of the overflow pipe should be approximately 3 feet below the top of the dam and 1 foot below the emergency spillway. A sleeve pipe fitted around the drain pipe to within several feet of the pond bottom and above the level of the drain

will remove poor quality water from the bottom as fresh water enters the pond.

A grassed, earthen emergency spillway is required to remove large quantities of water during heavy rainfall so that water does not flow over the top of the dam. Emergency spillways vary in width depending on watershed size, expected intensity and amount of rainfall, watershed slope, watershed vegetation type and soil type. Large ponds may require spillways wider than 100 feet, although 10- to 50-foot widths are more common. Horizontal bar barriers should be erected on spillways so that fish do not escape. Maintain these barriers so they do not clog and cause water to overflow the dam.

Drains and pond bottoms

Drain pipes should be installed at the lowest point in the pond. Drains should be sized so that ponds can be drained within a few days of opening the valve. A barrier should be built at the opening to the drain to prevent fish from escaping. Contact your district office of the U.S. Soil Conservation Service for more information on drainage structures. All trees, stumps, roots, rocks and other trash should be removed from the pond bottom to permit seining. The pond bottom should be smooth and gently sloped to the drain so that all the water drains out. Excavated "harvest" basins should not be constructed in watershed catfish ponds as they create too many difficulties.

All areas of the pond should be 2.5 to 3 feet deep to prevent aquatic weed growth and to allow better utilization by the fish. Shallow necks at the upper end should be eliminated so that oxygen-distressed fish cannot congregate there.

Water supplies

The biggest disadvantage of watershed ponds is erratic water supply. Dependable rain for tilling ponds usually occurs during winter and early spring in the Southeast. Because fish are often inventoried

and/or grown until late spring or summer for processors, draining for harvest then will result in the loss of months of production.

Building ponds in series can also help to keep most acreage in production year-round. Plan harvests to drain the bottom pond first, then successive ponds in that series will supply water to the lower ponds.

Low ponds or ponds with temporarily extended overflow pipes can be used to store water. When the harvest operation is complete, water can be drained or pumped back into the harvested pond.

Costs of construction

The curves in Figure 1 were developed by the engineer at the Alabama Fish Farming Center and are for ponds built in West Alabama. The curves are estimates for data generated during 1987 and 1988. Cost estimates include clearing, earthfill, excavation, pipe and drain, concrete,

seeding and road gravel. "Sided" refers to sides of the dam. The dimension 8 to 10 feet refers to the maximum depth of water at the stand pipe. Each pond site is unique and these curves should be used only

for rough estimates and comparisons. Obviously large, shallow, one-sided watershed ponds are relatively inexpensive to construct. Three-sided ponds may cost about twice as much as one-sided ponds.

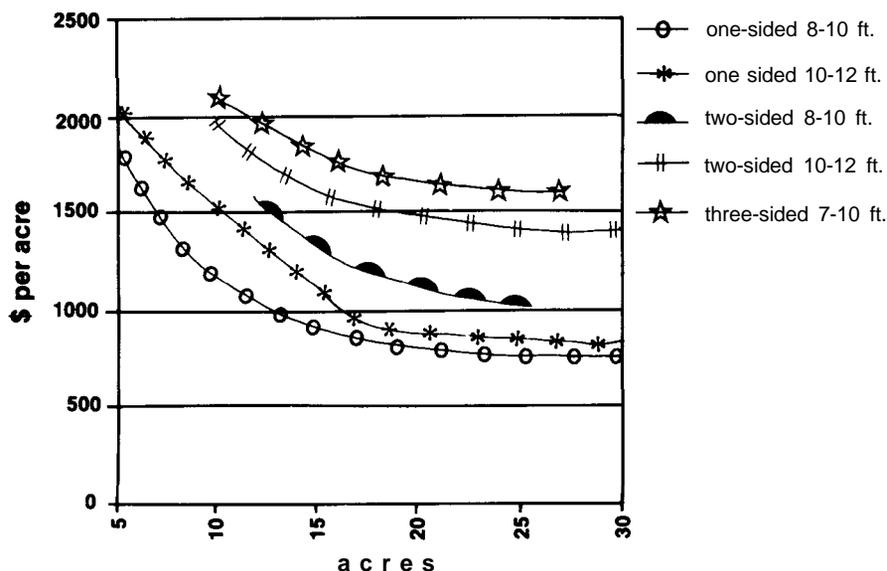


Figure 1. Comparative rough construction costs for standard hill pond.

Catfish Production in Watershed Ponds

The principles followed for growing catfish in levee ponds and watershed ponds are basically the same. However, certain differences may have a significant impact on profitability.

Stocking

Stocking rates are determined by the risk that growers are willing to assume. As stocking rates increase, feeding rates must increase, resulting in more fish waste, an increase in oxygen demand and more risks.

Low-risk stocking densities are less than 2,500 fish per acre to grow to 1 pound each. Highest feeding rates would require about 30 pounds per acre per day. Risks increase as standing crop increases to 6,000 fish per acre which is about the economical limit that technology will allow

today. At 6,000 pounds per acre, feeding rates would have to reach 90 pounds per acre per day. Dependable aeration equipment and use of good management enable most producers to reach standing crops of 4,000 to 4,500 pounds per acre.

If ponds are constructed for seine-through, larger fish can be topped off during the growing season until the fish are completely harvested. Ponds managed by topping usually yield more fish per acre per year while standing crops and feeding rates are maintained at less than maximum. Seine-through ponds must be constructed so that during harvesting, most fish can be captured without draining. Fish that escape harvest grow large and increase feed conversion.

Feeding

Good quality commercial feeds are essential for producing catfish. Wheeled feed blowers can be used to spread feed around watershed ponds but this may require graveled roadways around the entire pond. Feeding only from a short dam may restrict feeding activity resulting in slower and differential growth rates. "Pecking orders" are encouraged by restricted access to the food.

A better way to feed fish in a watershed pond is by boat because feed can be spread over large areas. Boats or barges should be equipped with hoppers for bulk feeding.

Avoid feeding in shallow areas of watershed ponds. Most fish

producers use floating feeds, but if sinking feeds are used, do not feed in water more than 4 feet deep.

Water quality and aeration

Water quality problems may be more severe in watershed ponds than in levee ponds because of inherent problems. Greater depth of watershed ponds, which results in summer stratification, contributes to water quality problems.

Surface water warms during late spring and summer, decreasing its density and resulting in a layer of oxygenated water 4 to 6 feet deep floating over a large layer of cooler, denser oxygenless water. This stratification may last for a few days to months. Problems develop when these two layers mix. Mixing occurs with wind or when surface water sinks after being cooled by rain or cool weather. This occurrence is called a "turnover."

Oxygen concentration is diluted and bottom organic matter and dissolved metals deplete available oxygen. Often the algae die resulting in a lack of oxygen production and an additional demand for oxygen from the decaying dead algae.

Large, catastrophic fish kills often occur after a turnover. This same type of turnover does not occur in shallow levee ponds because they usually mix or turn over every night and water near the bottom is rarely oxygenless.

Aerators should be available for times when oxygen is low either from turnovers or through normal respiration. Electrical service should be available at every pond so that stationary electric paddlewheel aerators can be used. Equipping watershed ponds with electricity is more expensive than equipping contiguous levee ponds because

more wire and poles are required. At least one horsepower per water surface acre should be used.

Aerators are more difficult to place in watershed ponds because their irregular features make the best circulation pattern difficult to determine. The best location is usually the middle of the longest side which could be along a bank or the dam. Water should be directed perpendicularly away from the longest side.

Aerators should be started before oxygen concentrations reach 3 ppm. Fish will then train to the aerator and stay in its current. As fish swim closer to an aerator and oxygen levels continue to drop, additional aerators should be placed near the aerators already in service. It is necessary to have portable, tractor-driven paddlewheels or pump spray aerators for severe problems. Electric paddlewheel aerators sized at 1 to 1.5 HP per acre usually cannot keep oxygen concentrations sufficiently high after algae die-offs or turnovers.

Fish stressed by low oxygen in a watershed pond are usually attracted to the upper end or "neck", recognized as the source of oxygenated fresh water. Supplies of this fresh water are usually not enough to hold large quantities of fish, and the fish may panic and suffocate. Fish should be prevented from entering the upper end of a watershed pond by early aeration and attracting them to higher concentrations of oxygen somewhere else in the pond. If fish do accumulate in the neck of the pond nearby aeration should be directed to that area and fish should be physically cut off from its upper reaches by a fence or net.

Harvesting

Watershed ponds should be clear of all stumps, rocks and trash so that a seine can be used for harvest. Low-

ering the water level to 5 to 6 feet deep at the drain is the easiest way to harvest. Seining in this area which may cover 20 to 50 percent of the pond can be done readily by moving fish to areas 3 to 4 feet deep on either side of the drain.

In very deep ponds, fish can be loaded into aluminum drag buckets and slid up near the drainpipe by a hydraulic boom and winch and loaded onto a live-haul truck. Booms equipped with loading baskets can be used in most watershed ponds to reach out over the water from the dam. Fish pumps may also have some application in loading fish out of watershed ponds.

When small quantities of fish are needed, they can be captured by use of a trapping seine. A 100- to 200-foot seine, set 6 to 10 feet deep, can be placed 25 to 50 feet from shore and parallel to it. Coiled ends of the seine can be connected by a rope to the shore so that the seine can be drawn around fish feeding between the seine and the shore. Trapping fish this way allows producers to catch small quantities (up to 2,000 pounds) without draining the pond. Unfortunately trapping is not dependable when fish are eating poorly or because fish shy away from trapping areas with experience.

Chemical treatments

The volume of water in watershed ponds may vary considerably from month to month. Know the volume of a pond at many pond depths to apply chemicals for disease or weed control, or other water quality treatments, in the correct quantities. While underestimates of pond volume may result in ineffective treatments, overestimates of volume may result in overtreatments and potential fish kills.

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