Auburn University and USDA-Natural Resources Conservation Service

Alabama Aquaculture Best Management Practice (BMP)

Managing Systems for Tilapia Culture

BMP No. 17

Definition

Tilapias (Oreochromis spp.) are increasing in popularity with consumers, and a number of fish producers in the United States are culturing them. During winter months in Alabama, surface water temperature falls too low for tilapia survival. Broodstock may be overwintered in waters heated by geothermal, solar, or mechanical means with spawning, nursery, and grow-out conducted during warm months. Alternatively, indoor culture systems with heating allow year-round culture, but energy for heating increases production costs.

Tilapia may be produced in tanks, raceways, cages, or open ponds. Although they are efficient filter feeders and use plankton for food, commercial feed is applied to increase production to profitable levels. Tilapia tolerate low dissolved oxygen and high ammonia concentrations better than most aquaculture species. Thus, they are stocked at high density, resulting in waters and effluents of culture units having high concentrations of nutrients, organic matter, and suspended solids.

Explanation

Because of the necessity to provide supplemental heat to overwinter broodstock or to extend the grow-out period, water reuse systems are popular in temperate areas. Ground water in Alabama usually is warm enough to permit tilapia survival in winter. Thus, broodstock can be overwintered in tanks through which well water is passed. Placing tanks under transparent plastic covers can lessen the volume of ground water that must be applied to fish holding units. In warm months, the same units can be used to produce marketable-sized fish under more intensive conditions.

Because fish are stocked at high density in culture units, a large input of feed is necessary. Mechanical aeration or oxygenation maintains adequate dissolved oxygen concentrations, but water is flushed through culture units at a rate of several exchanges per day to prevent high concentrations of ammonia and other wastes. Solids which accumulate on bottoms of culture units are removed periodically via a center drain (Figure 1) or by other means.

Water flushed from grow-out units must be treated to improve its quality and especially to remove suspended solids and ammonia before being reused. Suspended solids and other pollutants also should be removed from water discharged during tank cleaning before it is reused or treated and released into State waters. A popular treatment procedure for culture unit effluent is to direct it through a basin or wetland for sedimentation and to hold it for several days in an open pond to allow natural physical, chemical, and biological processes to improve its quality for reuse (Figure 2). Water reuse systems with more complex treatment schemes as illustrated in Figure 3 also can be used in tilapia culture. The intermittent effluent from such systems should be treated through a properly designed and maintained sedimentation basin before discharge into State waters.

Treatment ponds should be designed and managed to minimize overflow. Solids removed from ponds have high organic matter content and should be managed according to NRCS technical standards and guidelines.

Procedures for pond culture of tilapia are the same as those used in channel catfish culture. Fingerlings are stocked in ponds, feed is applied, and mechanical aeration is used to prevent low dissolved oxygen concentration. The main difference in pond culture of channel catfish and tilapia is the necessity to drain (recycle for reuse) and harvest tilapia ponds in the fall before onset of lethal cooler water temperatures.

Tilapia farm operations

Practices

All farms should install applicable practices from Aquaculture Best Management Practice (BMP) Nos. 1-15. Production systems that use a water treatment pond for improving the quality of water for reuse should include the following practices:

- *Management plans should be prepared by and practices implemented with the assistance of a professional engineer (PE) licensed in the State of Alabama or other qualified credentialed professional (QCP). Periodic inspections of the operation should also be conducted by a PE or QCP.*
- *A sedimentation pond with a minimum hydraulic retention time (HRT) of 4 hours should be installed between culture units and treatment pond.*
- *Treatment ponds should have a HRT of at least 14 days and preferably more*.
- *Mechanical aeration or water circulation should be applied to deep treatment ponds to avoid thermal and chemical stratification. Use of aeration also will enhance the capacity of treatment ponds to assimilate wastes.*
- *Treatment ponds should be designed to prevent overflow except during periods of rainfall. Overflow should be discharged from the surface of ponds through a stable outlet structure*.
- *Total feed input to culture units should not exceed a daily maximum calculated as follows: 100 lb × treatment pond* surface *area in acres. The daily maximum can be increased by 30 lb/acre for each horsepower per acre of aeration applied to the treatment pond.*
- *Sediment removed from the sedimentation area should be land* applied *in a responsible manner according to NRCS technical standards and guidelines.*
- *Dead fish should be removed from culture units daily or more frequently and* disposed *by burying, composting, or incineration according to NRCS technical standards and guidelines.*

Tilapia culture in cages should be done in accordance with BMP No. 19. Tilapia culture in raceways and open ponds should employ practices recommended in BMP No. 20.

Tilapia aquaculture operations that qualify as concentrated aquatic animal production (CAAP) facilities must comply with EPA effluent limitation guidelines, applicable NRCS technical standards and guidelines, and if required, ADEM NPDES permitting requirements.

Implementation notes

The minimum size of the sedimentation pond and of the treatment pond will depend on discharge from the culture units which is equal to the inflow rate. The following equations may be used to calculate the minimum volumes for sedimentation and treatment ponds.

(1) Daily discharge of culture units (ft^3) =

$$\frac{\text{Water inflow (gpm) x 1,440 min/day}}{7.42\ \text{gal/ft}^3}$$

(2) Sedimentation pond volume (ft^3) = Daily discharge of culture units (ft^3) $\div \dfrac{\text{24 hr/day}}{\text{4-hr HRT}}$

(3) Treatment pond volume (ft^3) = Daily discharge of culture units (ft^3) × HRT (days)

To illustrate, suppose the inflow is 700 gpm. The daily discharge of culture units will be:

$$\frac{700\ \text{gpm} \times 1{,}440\ \text{min/day}}{7.42\ \text{gal/ft}^3} = 135{,}849\ \text{ft}^3$$

The minimum sedimentation pond volume will be

$$135{,}849\ \text{ft}^3 \div \frac{24\ \text{hr}}{4\text{-hr HRT}} = 22{,}641\ \text{ft}^3$$

The minimum treatment pond volume will be

$$135{,}849\ \text{ft}^3 \times 14\text{-day HRT} = 1{,}901{,}886\ \text{ft}^3$$

Maximum depth for the sedimentation pond should not be more than 3 ft. The average depth of the treatment pond should not be greater than 8 ft.

The best procedure for preventing stratification in the treatment pond is to install mechanical aeration and operate it during spring, summer, and fall. A propeller-type water circulator is an option for preventing stratification. However, aeration is a better choice because it oxygenates pond waters and increases the capacity of ponds to assimilate wastes. Ponds less than 6 ft in maximum depth usually will not stratify thermally, but aeration will increase their assimilation capacity.

The permissible daily feed input to culture units is estimated from treatment pond area and amount of aeration applied. The following guidelines can be used to obtain a factor to multiply by pond area to give maximum daily feed allowance:

Aeration applied (hp/acre)	**Daily feed allowance (lb)**
0	100
1	130
2	160
3	190
4	220
5	250
10	430
15	510
20	690

For example, suppose that a treatment pond has an area of 5 acres and one, 10-hp electric paddlewheel aerator has been installed. The maximum daily feeding rate for culture units would be 800 lb (160 lb/acre × 5 acres).

Tilapia producers should refer to BMP Nos. 1 and 2 for practices that may be implemented to lessen treatment pond overflow. BMP No. 6 concerns the construction and operations of wetlands and settling basins for effluent treatment. Fish mortality management is considered in BMP No. 13. Chlorides concentrations and saline water management is considered in BMP No. 16.

References

ADEM Administrative Code Chapter 335-6-6. (NPDES Rules)

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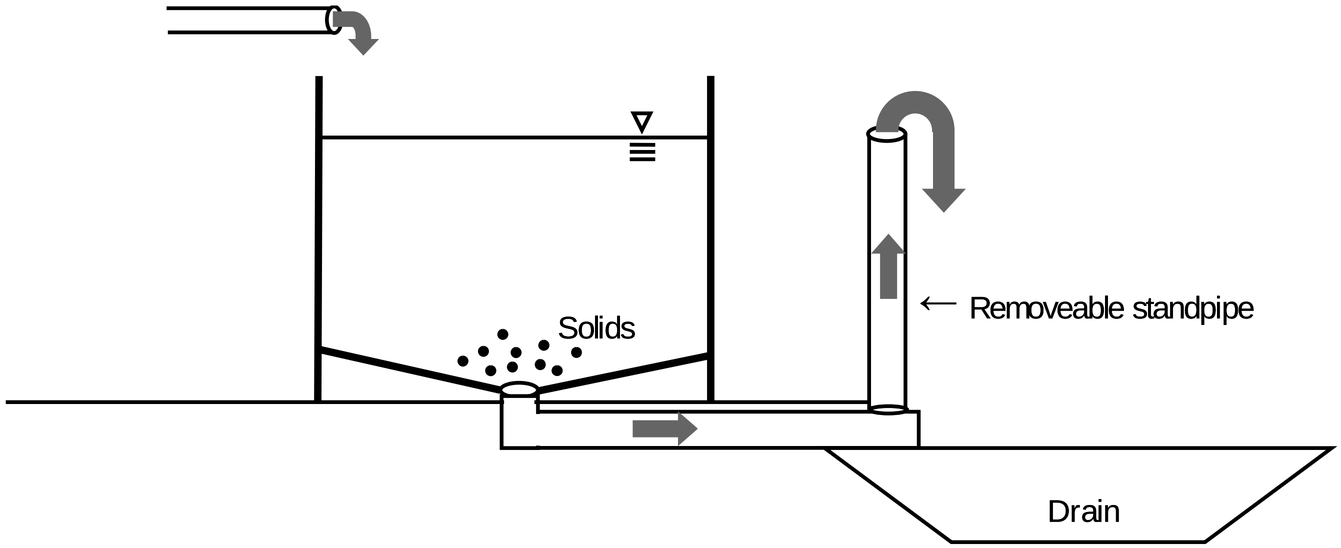

Figure 1. Illustration of intensive fish culture unit with center drain. When the standpipe is removed, the solids will be flushed from the tank.

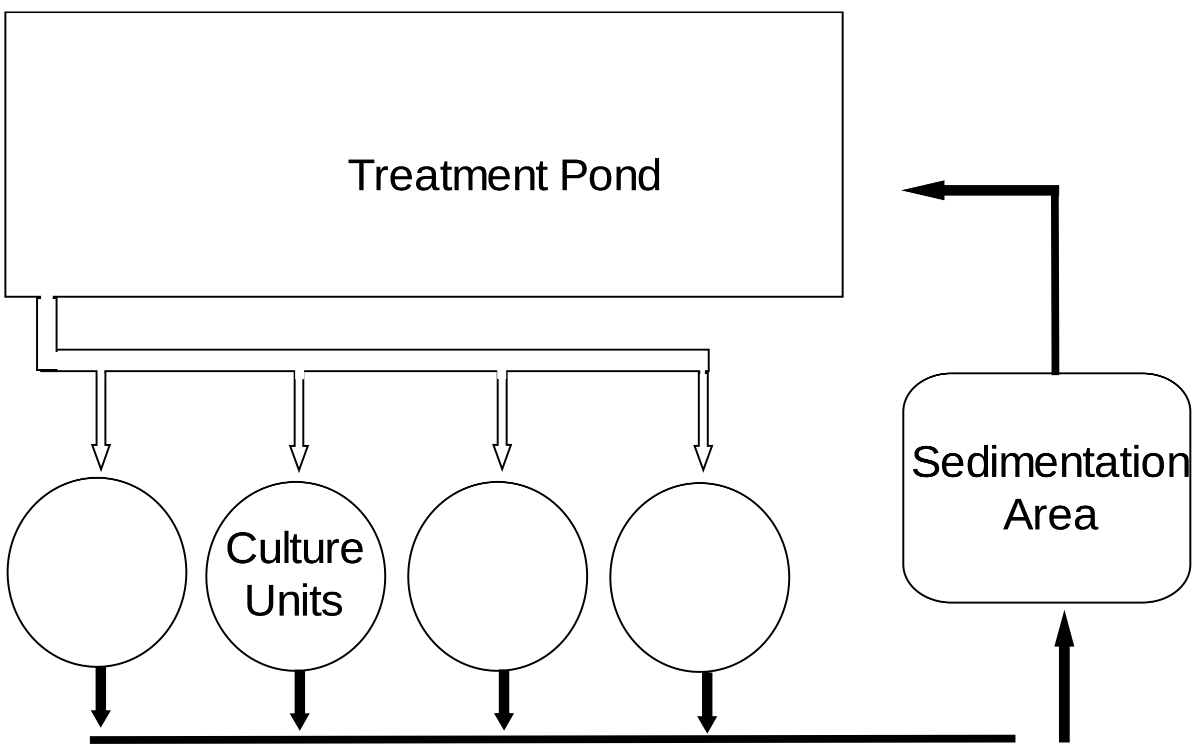

Figure 2. Illustration of aquaculture production systems with intensive culture units, sedimentation area, and treatment pond. Drawing is not to scale.

Figure 3. Illustration of an indoor, intensive aquaculture system with waste treatment processes. Drawing is not to scale.

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