POND CONSTRUCTION AND MANAGEMENT

Fish Pond design and construction

A typical earthen fish pond should be 300m^2. The main physical factors to consider are the land area, water supply and the soil water retention capacity.

Land area

The projected land for fish pond construction should be relatively level. Steeply sloped land is not suitable for building ponds. A slope of about 1% is ideal. A farmer should determine an area large enough for the present plans any future expansion. Such an area should not be prone to flooding. The selected area should not be subject to pollution in runoff from adjacent land. If possible, the land must be slightly lower than the water source, so that the ponds can be filled by gravity rather than by pumping.

Water supply

The most common sources of water used for aquaculture are surface waters (streams, springs, lakes) and groundwater (wells, aquifers). Wells and springs are generally preferred for their consistently high quality water. The quantity and quality of water should be adequate to support production. A good water source will be relatively free of silt, aquatic insects, potential predators, and toxic substances, and it will have high concentration of dissolved oxygen.

Warm water species like tilapia can tolerate water with lower dissolved oxygen levels, so tilapia culture is often done in static water, that is, without water flowing through the ponds. For earthen ponds, the water source should be able to provide at least 1 m^3 of water (1000 liters) per minute for each hectare of ponds that will be built. If the selected site has relatively poor soils (i.e., soils containing too much sand) the source should be able to provide two to three times more water (2-3 m^3 per minute per hectare).

Soil

Land should be comprised of good quality soil, with little or no gravel or rocks either on the surface or mixed in. Farmers should consider importing clay soil for compacting in the fish bottom, sides and core trench to minimize seepage. Soil that will be used to build the dykes must contain at least 20% clay so the finished pond will hold water throughout the growing period.

Some soil with higher clay content—preferably between 30 and 40%—should be available nearby. It will be used to pack the core trenches in the dykes.

In absence of good soils, farmers should consider using dam liners or concrete during fish ponds construction.

Pond design and layout

General considerations

• Depends on the type of soil present and the intended culture practices.

• The water source must be able to keep the pond full throughout the culture period.

• Relatively shallow ponds are productive, but the shallow end should be at least 0.5 m deep to avoid invasion by weeds.

• It is always desirable to place screens on pond inlets and outlets to keep out predators, insects, and unwanted fish, and to retain the cultured fish.

• Every pond should be drainable.

• Every pond should have an independent controlled inlet and outlet.

• Excavation of a core trench should be done where soils are less suitable.

• Perimeter and feeder roads are required to provide for movement of machines during construction and at harvest.

• If you plan to drive on the dykes, build them at least 3 meters wide on top, and wider at the base.

• Soil used to build dykes should always be compacted in layers.

Specific design considerations

1. Water sources used for fishponds

• Water sources can be spring water, seepage water, rainwater or run-off, tidewater (marine ponds), water from bore holes (wells),or water pumped or diverted from a river, lake, or reservoir.

Quantity of water needed

• Make a decision on the type of fish to be cultured and the size of ponds, so as to determine the amount of water required.

• Consider the climatic condition of the area, rainfall pattern, and nature of the soil when

calculating quantity of water.

• A general rule is that pond water inflow and outflow should equal the pond volume over the period of a month. If inflow is too low, water quality may suffer from oxygen depletion and/or the accumulation of toxicants. However, if the inflow is too high, large amounts of beneficial algae may be flushed from the pond.

• As a rule of thumb, ponds should fill up in less than a week. For small ponds, e.g., ponds smaller than 200 m2, 1-inch pipe is recommended. A 400-m2 pond needs a 2-inch pipe, while a pond larger than 4000 m2 will require a 4-inch pipe (see Table 2.1-1).

• Estimate the amount of water available from a specific source,

Steps

1. Survey the land
2. Clear all vegetation from the site
3. Remove the topsoil from the site
4. Determine pond, drain pipe, and supply canal elevations
5. Peg out the pond, including core trenches, dyke tops, and dyke toes
6. Dig core trenches and pack them with good soil
7. Excavate the pond area
8. Build the dykes
9. Install the drainage system
10. Install the water supply system

Building your pond

1. Surveying the land

• Clear the land to get line of sight.

• Select a reference point for the survey. The standard reference point (―bench mark‖) is sea level (0 m above sea level). However, in pond construction we use a Temporary Bench Mark (TBM) to help determine elevations and establish slopes. If there is an existing pond use it as the reference point to get the heights of your dykes. If there are no existing ponds, use a fixed point on an inlet or outlet canal as the TBM.

• Start measuring elevations from the supply canal using a level and twine. Determine slope from dyke top to pond bottom for both Vertical and horizontal dimensions. This helps in understanding how water will flow from the pond to the drain or back to the river.

Raise elevation into canals by blocking with timber or sand bags.

• Survey across water bodies using objects such as bamboo, pipes, etc.

2. Clearing vegetation

• Vegetation should not be included in the soil used to construct the pond dykes, so should be removed from the site prior to beginning to excavate and move soil.

3. Removing topsoil from the site

• Topsoil is not good material to use for dyke construction, so it should be removed prior to excavating the pond.

• Topsoil can be set aside and spread over the dykes after construction is complete, or it can be moved for use elsewhere on your farm.

4. Determining pond, drain pipe, and supply canal elevations

• Determine topography (layout) of the land first.

Remember that the elevations of the pond inlet and • the outlet to the drain canal determine the elevation at which the pond drain can be placed. Hence the difference in the elevations of the inlet and the outlet determines how deep your pond can be.

• Remember to allow for the freeboard.

• Canal slopes generally range from 0.25% to 1%.

• Cross check your levels to correspond with the TBM so as not to lose dyke height.

• You can also check your pond diagonally, widthwise, and lengthwise.

5. Pegging out the dykes and core trenches

• Decide on the size of the pond and peg the pond area.

• Decide on the dyke slope and width.

• Place pegs at the inner toes, including the four bottom corners. The ―toe‖ is the point where the dyke slope meets the pond bottom. To do this, multiply the desired slope of the dyke by the desired pond depth. For example, at the deep end, the inner toes will be 80 cm x 2 = 160 cm, while at the shallow end the inner toes will be pegged at 75 cm x 2 = 150 cm.

6. Constructing cores

• If you suspect the dyke or pond bottom soil to be highly permeable, dig a core trench under the dykes around the pond.

• Pack the core trenches with impermeable clay.

7. Excavating the pond area

• Make a decision on pond depth and calculate the dig/fill heights
• Begin excavating the pond bottom.

• Plan where you take soil from and where you take it to.

• A two-person stretcher works better in black cotton soil than a wheelbarrow.

8. Constructing the dykes (levees)

• The most important component of a pond is its walls (also referred to as the ―dykes,‖ ―levees,‖ or ―embankments‖).

• Use soil excavated from the pond area to construct the dykes.

• Construct the dykes gradually, in layers about 20 cm thick at a time.

• Compact each layer before the next layer is put down.

9. Installing the drainage system

• Install the drain after the dyke has been raised at least above the original ground level.

• Cut a trench for the drain pipe across the dyke at the selected point in the deep end.

• The top of the drain pipe should be below the deepest part of the pond.

• Lay the pipe at the proper slope through the dyke; slope should be not less than 1%.

• Install at least one ―anti-seep collar‖ along the drain pipe (or small ponds, a PVC pipe fitted with a • gate valve would be more suitable `than a monk with timber boards.

• Place a screen at the outflow to keep out predators and unwanted fish, and to retain the cultured fish

A prototype measuring a total of 300 m^2 have been used by Kenya Government as a blue print in all constituencies. The general features of the pond looks as shown in the figures 1, 2, 3, 4 and 5 below:

Zoo-08-GE
1.2

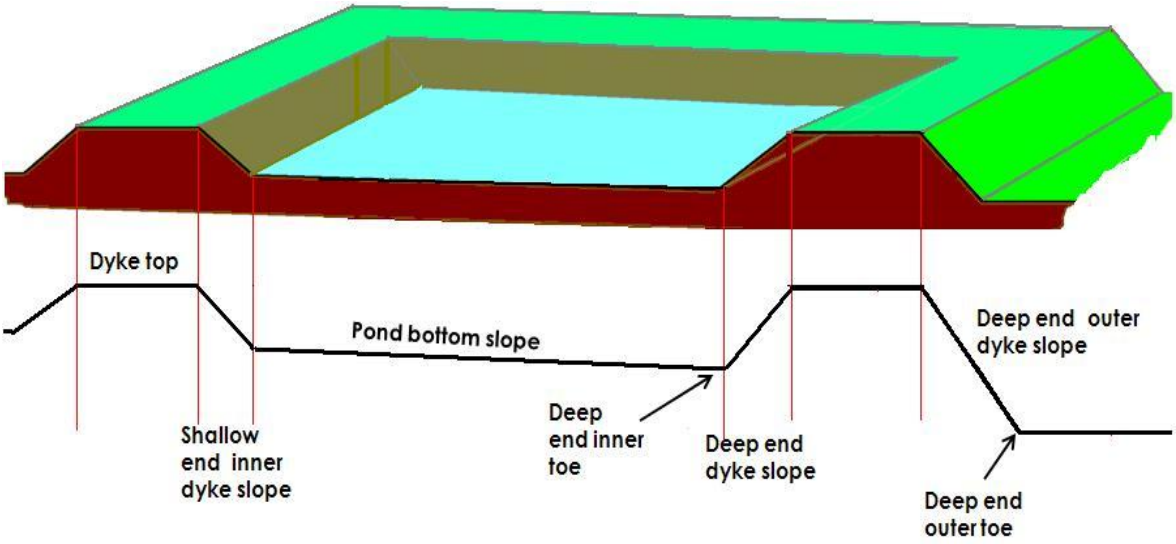

Figure 1: A cross section of an earthen fish pond showing the slopes and the dykes

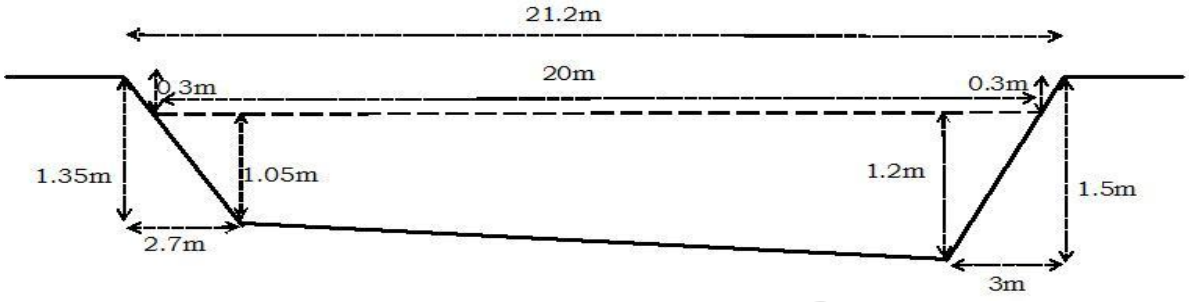

Figure 2: Length wise section of the pond showing the various measurement.

Pond Management

(i) Fertilization

Aside from feeds and water management, the following pond maintenance procedures are carried out: regular application of fertilizers, lime, and pesticides; prevention of entry of predators; monitoring of the stock for growth rate determination as a basis of feeds and water management; and regular pond upkeep and maintenance.

Extensive ponds are fertilized regularly using either organic fertilizers like chicken, cow, or pig manure, or inorganic fertilizers like urea, ammonium phosphate, or both, to maintain the plankton population in the pond. The fertilizers are either broadcast over the pond water surface or kept in sacks suspended from poles staked at certain portions along the pond periphery. Semi-intensive and intensive culture systems do not require fertilization since they are not natural food-based, except for those which grow plankton-feeders like milkfish whose diet is largely algae dependent.

(ii) Liming

In addition to fertilization, ponds also need to be given regular doses of lime to maintain water pH at alkaline or near-alkaline levels (preferably not lower than six). Agricultural lime is broadcast over the pond and applied on the sides of the dikes to correct soil and water acidity.

(iii) Elimination of Pests and Predators

Unwanted and predatory species which may have survived the application of pesticides during pond preparation or which were able to enter the pond through the gate screens or through cracks in the dikes, are eliminated by the application of pesticides, preferably organic, into the pond.

Crabs, which are a serious problem in shrimp ponds because they are carnivorous and cause damage to the pond dikes, are not usually affected by known pesticides and are therefore best eliminated by the use of crab traps situated in the pond.

It is also important that the gates are properly screened and the screens kept whole, to prevent the entry of small unwanted fish into the pond. Double screens are usually installed at the main intake to ensure that pests and predators are prevented from entering the pond system.

(iv) Stock Monitoring

The culture organisms are monitored closely and regularly to determine their rate of growth and the general condition of the stock. They are regularly sampled for length-weight measurements as a basis for determining/estimating their biomass in the pond and therefore their daily feed rations, as well as for making projections on harvest schedules and procurement of pond inputs.

In the first few months of culture, the feeding tray is a good tool for stock monitoring, as explained in Section 4.3.5.3. As the organisms grow in size, cast-netting is used as a sampling tool, with those caught in the throw of the cast net providing an indication as to sizes and weights of stock. Based on the sampled weights and the daily feed consumption, it is possible to predict the available biomass (i.e., stock surviving after initial mortalities) and make projections on volume of harvest. For this purpose, it is essential that accurate records are kept for analysis at a later time. Data on initial size/weight and number of fry/post larvae stocked, average body weight at each sampling, and feed consumption on a daily basis, are important to have on file.

(v) Regular Upkeep and Maintenance of Facilities

The pond dike and gates are checked regularly for cracks that could lead to seepages and losses of stock. The dikes are best planted with grass or vegetative cover to prevent erosion. The gates and other support infrastructure are properly maintained for efficient operation.

4.3.5.6 Harvesting

Marketable-size fish/shrimps are harvested at the end of the culture period by draining the pond and using harvesting nets to catch the fish or shrimps. The latter are harvested with a bag-net attached to the sluice gate as water is drained out of the pond at low tide. Tilapia are harvested using seine nets after the pond water is drained to half-level the night before.

Harvest of milkfish takes advantage of their behaviour of swimming against the current. The method, known in the Philippines as "pasulang" or "pasubang" involves draining 85-90% of the pond water during low tide and allowing in the water at the incoming high tide so that the fish swim

against the current through the tertiary gate and into the catching pond, whose gate is closed once a large number of fish is impounded. The fish in the catching pond are then harvested by seining and the rest hand-picked.