III: FISH POND QUALITY

INTRODUCTION

Fish ponds are unnatural aquatic ecosystems that farmers must manage in order to produce profitable fish crops. Physical characteristics of a fish pond directly impact pond water quality and indirectly the whole ecosystem, and, therefore, production management potential for the farmer. The influences are common to all pond technology systems and are not unique to 80:20 pond culture. Once a pond is constructed, the physical characteristics are essentially permanent. Farmers are left without practical means of correcting site, design and construction flaws, and must rely on excess management techniques to compensate for them. The objective of this section is to discuss desirable and undesirable physical qualities of fish ponds relative to management potential.

POND TYPES

Fish ponds typically fall into two types; excavated pond built on a relatively flat land with water basin formed by surrounding dikes; contour pond built in a shallow valley with a basin formed with a single dike (dam) across the valley. Contour ponds are typically difficult to manage and often impractical for raising fish, principally because of excessive depth, irregular shoreline, uneven bottom and lack of water supply control. They cannot be standardized relative to design and engineering features, because they must take the shapes, areas, depths and bottom configurations dictated by characteristics of the valley. In contrast, excavated ponds may be standardized with duplicated design and engineering features, including identical shapes, areas, depths and bottom configurations. Consequently, excavated ponds are much more easily and predictably controlled, and allow for development and application of more scientific and standardized farm management systems.

FISH POND CRITERIA

The following are preferred physical features of fish production ponds with brief explanations of reasons for them:

1. Farm accessible to markets and supplies - The shorter the distance and the better the roads to markets and supplies, the lower the transportation costs and the less stress to health and general condition of the fish going either from farm to market or stock source to farm.

2. Pond above water table - Ponds should be entirely above the water table to prevent ground water from seeping into the pond, to assure complete draining of the pond at harvest, and to facilitate both water fill and drain by gravity.

3. Soil impervious to water - Pond bottom and lateral (dike) soils should be relatively impervious to water to prevent seepage loss. Loamy clay soils are preferred, because they are impervious and are easily worked when constructing ponds. Pervious soils are undesirable, because they require costly management to maintain, and concrete and other pond liners to control seepage are generally impractical and cost ineffective.

4. Water source quality and quantity relatively unlimited - An ideal fish farm water source is unlimited in quantity and quality and under the total control of the farm manager. Adequate quantity to fill and replenish lost water from draining, seepage and evaporation is essential. Quality of that water must be of at least minimum standard for direct use to partially or totally fill ponds. Water from below ground is usually excellent, especially for hatchery and nursery facilities, but may require temperature, oxygen and carbon dioxide/pH conditioning that may be costly if large quantities are used. Open waters, such as canals and rivers, may be convenient sources, but they may contain harmful contaminants, such as agricultural and industrial pollutants and discharges from neighboring fish farms. Seldom do farm managers have total control over their water source, and near-future environmental laws will likely limit farm use of all water sources as well as farm water discharges.

5. Pond water fill and drain by gravity - Gravity filling and/or draining of ponds is desirable, as mechanically transferring water into and out of ponds can be costly due to equipment, energy and other operating costs.

6. Ponds accessible to public electricity - Aerators, water pumps and other power equipment are essential tools on modern fish farms. Electricity is the least costly, least troublesome and most reliable source of energy, and electric powered equipment is the most energy efficient and reliable and least costly to maintain and operate.

7. Area of each pond within 0.2 to 2.5-ha range - Fish ponds vary in area from <0.1 ha to >10 ha, generally with smaller ones used for stock production and larger ones for growout. Pond area is not a critical factor to production, and when designing new ponds farm managers may use their judgement as to pond area they prefer. Larger ponds are less costly to build, but they require larger equipment to operate, and problems of harvest are far greater with larger ponds. At optimum yields of 4 to 7 mt/ha with 80:20 culture, pond areas ranging from 0.2 to 2.5 ha are recommended.

8. Pond shape rectangular - Rectangular ponds are practical to construct and the most practical to manage.

9. Average pond depth 1.5 m - Average pond depth should be no greater than about 1.5 m, with maximum depth not exceeding 1.7 m. Deeper ponds are more expensive to construct and to manage, and they provide no added benefits. Construction of a 2-m deep pond would require digging, transporting and depositing 5,000 m^3 more soil per hectare than for a 1.5-m deep pond. Usually the simplest way to get rid of dug soil is to deposit it on the dikes, which creates management problems and results in added long-term costs. Fish ponds deeper than about 1.5 m thermally and chemically stratify at about 1.2 m. Water quality below that depth becomes anaerobic and unsuited for fish life, and if the quantity of that water is large, such as in 32 m deep ponds, it will stress and possibly kill the fish population when it is mixed with the pond water above the stratified layer, and it inevitably will be. Stratification can be prevented with aerator/mixers, but that requires daily use of the equipment, which is another unnecessary cost resulting from constructing a pond too deeply.

10. Bottom slope continuous at 1-2% to drain end - Pond bottoms should be firm, with even surfaces (without pot-holes) and gently sloped at about 1-2% from the shallow end to the deeper drain end to facilitate complete water drain and harvest without having to pick up stranded individual fish by hand.

11. Dike height within 30 to 50 cm range - Low dike height is preferable to high dikes for four primary reasons: 1) they are cheaper to construct and maintain; 2) they are more practical for routine work, such as feeding, seining and checking water quality; 3) they allow freer movement of air currents over the pond that improve surface water quality conditions; and 4) they contribute less eroded silt to the pond water and soil. High dikes are usually a result of digging ponds too deeply.

12. Dike slope 1.5:1 from top to bottom - Dike slope of about 1.5 units laterally for each 1 unit of height is preferred, because such slopes help prevent dike collapse, and they are more easily maintained than steeper sloped dikes. Undesirable vegetative growth may develop in the water along the shore of shallower sloped dikes.

13. Dikes erosion protected - Top surfaces of pond dikes should be completely covered with sod to prevent deterioration of the dikes and prevent erosion siltation of the pond water and bottom soil. A rip-rap collar extending vertically about 15 cm below and above the water line around the entire pond will help prevent both erosion and dike collapse. With 80:20 technology and proper erosion control, pond bottoms will not accumulate the anaerobic muds common in traditionally managed ponds in China.

14. Open land space adjacent to ponds - Ponds should be accessible by small trucks to facilitate delivery of supplies and loading removal of harvested fish. Trees and buildings next to ponds obstruct flow of beneficial air currents over the pond surface.