The Do's and Don'ts of Pond Construction and Repair
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Let's begin by asking the question "Where does trouble start?" with regard to pond construction. Three areas that lead to eventual problems include the selection or use of unsuitable sites, poor construction, and inadequate maintenance. This discussion therefore focuses on the "Do's and Don'ts" of **Site Selection**, **Pond Construction**, and **Pond Maintenance and Repair**.

Site Selection

Selection of a good site will lead to success with the pond; selection of a poor site may lead to failure in one way or another.

Some things we should be sure to do include:

1. Carefully evaluate the physical and chemical factors that make or break a site—

   Soil

   - Evaluate for soil texture throughout the area. At least 20% clay content in the soil is needed, and cores should have even more clay. Sandy clay loam, clay loam, silty clay, and silty clay loam are generally suitable. Sand, loamy sand, sandy loam, loam, silty loam, and silty clay loam are too permeable. Clay and sandy clay have too much clay in them.
   - Determine if there is sufficient clay in the pond area to build the dam. It is best to avoid having to bring in clay soil from outside.
   - Determine if there is sufficient clay depth in the dam area to prevent seepage. Thin layers of clay may allow seepage and resulting problems later on.

   Water

   - Determine that there is a sufficient quantity of water available to keep the pond full
   - Determine that water quality is good enough for fish health and growth. Water should be free of pesticides or other toxic substances, not too enriched by agricultural practices uphill, not too muddy, have good hardness, alkalinity, and pH.

   Topography

   The idea is to locate a pond where the largest storage volume can be obtained with the least amount of earth fill needed to build the dam—i.e., "the biggest bang for the buck."

   - Determine that the ratio of pond area to dam size is suitable
   - Determine that the dam size and cost of construction are not too great
   - Determine what size of dam (length and height) will be required, given the topography

2. If considering a production operation with market output, then also carefully evaluate the social and economic factors that make or break an operation—

   Markets

   - What species and sizes of fish are acceptable to buyers

- What prices will people pay for different species and sizes of fish
- How do consumers expect fish to appear at the market: Live, fresh, frozen? Whole, gutted, filleted?
- How will fish be handled, processed, and transported to get from the pond to the market?

Availability of needed inputs

- Are fingerlings of the intended species readily available?
- Are fish feeds, fertilizers, or other chemicals needed for treatment available?
- What are the costs of all the needed inputs?
- What prices will people pay for different species and sizes of fish?
- How do consumers expect fish to appear at the market: Live, fresh, frozen? Whole, gutted, filleted?

Access

- Is power available at the site?
- Is road access reasonable, i.e, short and

3. There are also legal issues to be sure of:
   Water rights: Do you have or can you get rights to use water for/at the site?
   Regulatory issues
   - What regulations will apply to construction and operation at this location?
   - What permits will be needed to construct and operate at this site?
4. In any case, work up budgets that consider all physical, chemical, social, and economic factors related to the operation of ponds at this site
   - Enterprise budget
   - Cash flow budget

Some things not to do ("Don'ts) with respect to site selection include:

1. Don't select a site where soil, water, or topography is unsuitable
   - land is too steep, too rocky,
   - soil is too sandy
   - water is of poor quality or insufficient quantity
2. Don't select a site where there is no market for your product
3. Don't select a site where:
   - inputs are unavailable
   - access is poor
   - water rights are not available, or
   - regulatory issues will be a major constraint
   - failure of the dam could bring risk to people, livestock, or property

Pond Construction

As with site selection, starting out right will lead to success and starting out wrong can lead to failure. As the old adage goes, "An ounce of prevention is worth a pound of cure."

Pond Construction "Do's" include:

1. Do have all required rights and permits in hand prior to beginning
2. Do work with an engineer to design the pond
   - Be sure to include a core in all dams

- Include a drain/overflow in the design, including a good trash screen
- Be sure to incorporate an emergency spillway into your plan
- Also incorporate (a) diversion ditch(es)
- Be sure to allow for an appropriate amount of "freeboard" in your design

3. When beginning work:
   - Do clear the area of vegetation and topsoil prior to beginning construction
   - Incorporate core trenches under all dams or embankments; use the best available clay soil to pack the core. The core trench must go below all sandy or gravelly layers of the old stream bed and well into a clay layer
   - After compacting the first few layers of the core and dam, install a drain at the deepest part of the dam (usually at the bottom of the old stream bed). Use anti-seep collars to prevent seepage along the drain line
   - Deepen the edges around the pond perimeter to increase capacity and reduce the growth of macrophytes in the pond (weeds)(they really like the shallow areas)
   - Put in a diversion ditch to route excess runoff around the pond during heavy rains
   - Always install an emergency spill way to lead overflow water well around the end of the constructed dam. This is to handle water that the regular drain/overflow cannot handle, i.e., during flooding. We do not want water overtopping the dams or embankments themselves.
   - Raise the dam or embankments in (six-inch) layers, compacting each layer before spreading the next
   - When the dam is done, finish with topsoil and seed with grass to protect against erosion

Pond Construction "Don'ts" include:

1. Don't use topsoil in the construction of the dam
2. Don't make the slopes of dams too steep; 2:1 or more gentle slopes are best
3. Don't skimp on any of the following design elements:
   - Dam core
   - Overflow and drain
   - Emergency spillway
   - Diversion ditch (if needed—discuss with the engineer)
4. Don't encourage the growth of woody plants or shrubs on or near dikes

Pond Maintenance and Repair

Maintenance

A well-maintained pond will last much longer than one which is neglected. Catching little problems early will prevent them turning into big, expensive problems. Routine maintenance should include at least the following activities.

Do:

- Regularly monitor and inspect all parts of the dam
- Mow and fertilize grass on the dam and spillway to promote soil stability
- Prevent the growth of trees or brush on the dam or in the spillway
- Immediately repair any erosion in the spillway so it doesn't get worse
- Regularly remove debris from the trash screen
- Control muskrats, beavers, and nutria (!) as best you can

- Limit livestock access to prevent dike damage and muddying of the water

Repairs

Sometimes things just don't work out and repairs have to be made. Three common situations requiring repair include leaking ponds, slumping dikes, and washed-out dams. These often happen because an important aspect of pond design and construction was forgotten or avoided. Making repairs can be costly, and usually involves mostly ***"Do's,"*** as follows:

For leaking ponds:

1. If no core was installed in the original construction, try adding an "after-the-fact" core on the inside slope
2. If seepage is due to poor soils in the pond bottom, try adding a layer of clay and compacting it well (using a sheepsfoot roller is best).
3. Alternatives to adding a layer of clay soils include:
   - Add bentonite
   - Use a "plastic" liner

For slumping dikes:

1. Rebuild the dike with a more gentle slope. Be sure to use good quality (minimum clay content). This should prevent future slumping and may have other advantages as well, e.g., making it more difficult for nutria and other animals to damage the dikes

For washed-out dams:

Most such failures are due to overtopping of the dam during flood events. Perhaps the ratio of watershed area to pond size, or the potential amount of rainfall, or the nature of the watershed was misjudged during the design stage. Or perhaps the pond (dam) was built without adequate protection, i.e., without an emergency spillway or without other protective measures such as a diversion ditch. Recovery will likely be very expensive and will entail the following:

1. Rebuild the failed section or the entire dam, giving attention to good construction principles
2. In particular, the issue of dam overtopping must be addressed:
   - Build or enlarge emergency spillway
   - Construct diversion ditch?
   - Add another pond in the watershed?
   - Redesign water release (drain/overflow) structure?

Many internet and other resources to help with site selection, pond design and construction, and pond repair issues are available. Time allowing, these will be briefly discussed in the presentation, and they will also be made available as a separate handout at "Pond School 2007."