

**Fish Farming as a Business:
What you need to know about
the Characteristics of a Pond
as a New Farmer!**



Is there a sustainable solution for optimising
production?

Introduction

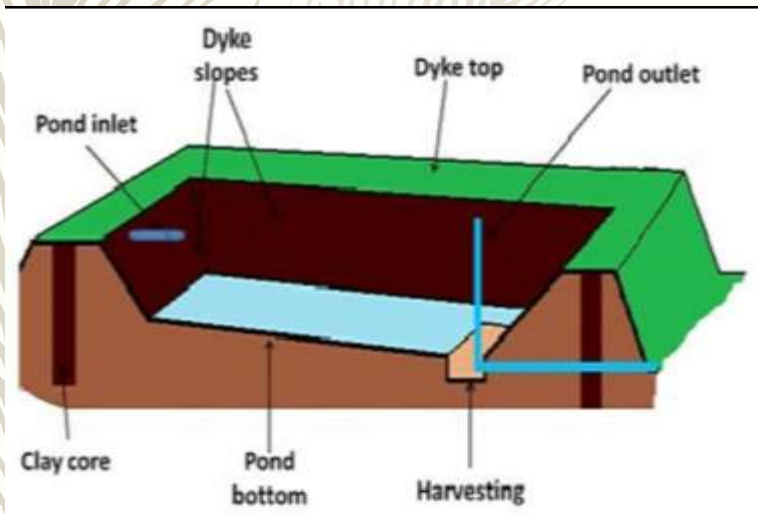
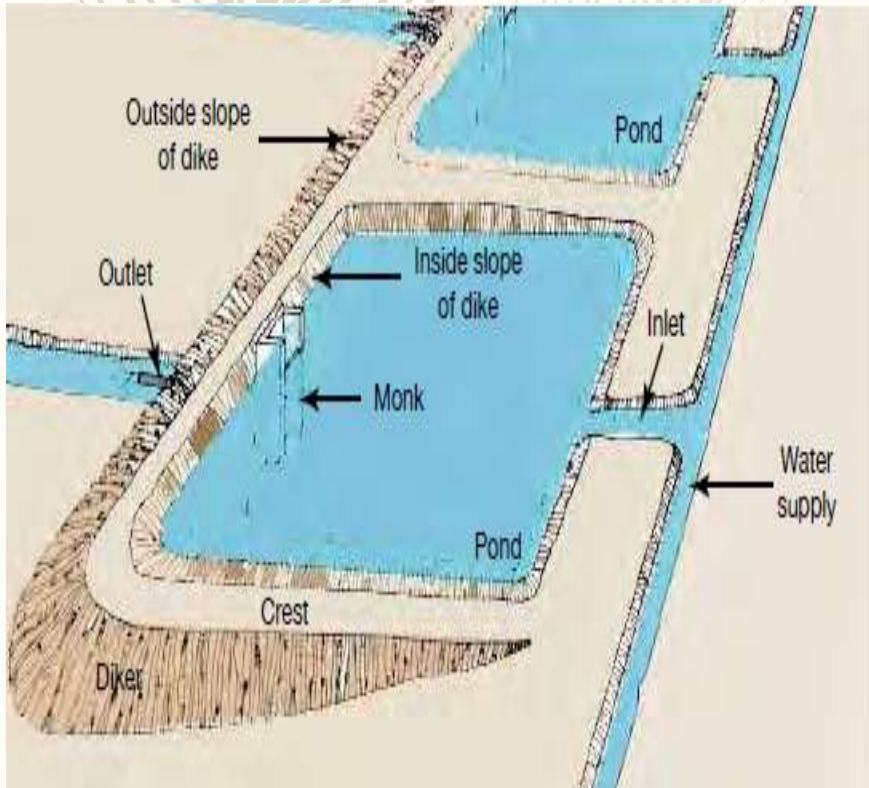


Figure 1: A cross section of a typical earthen fishpond showing the pond profile and important features (Source: FAO)

- ❖ This presentation will give us an overview of what we should know about the characteristics of Pond Constructed for fish culturing.
- ❖ After the pond installation sites have been chosen, the next step is to set up the ponds.
- ❖ Fish production requires earth ponds, which contain and renew fresh water, and can accommodate the storage, farming, and harvest of fish. Construction of the ponds and associated structures require specific preparations and tasks, which are essential for success.
- ❖ Moreover, the ponds must be inexpensive to build, easy to maintain, and tidy to ensure that the water and the fish are managed well.

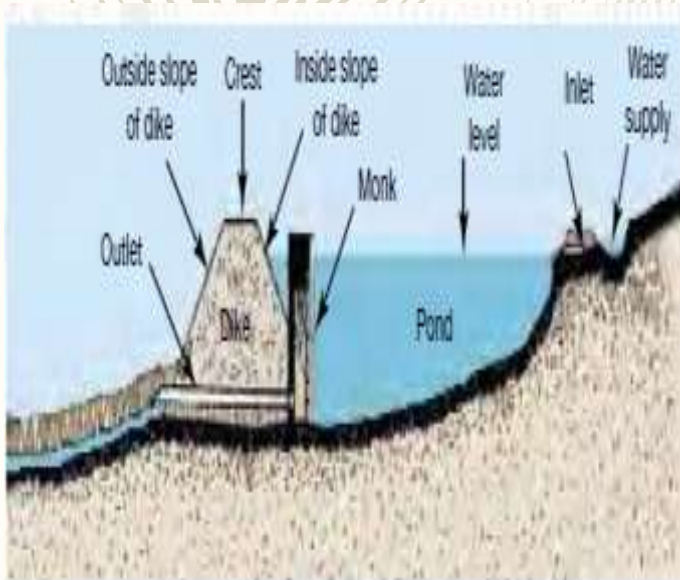
Pond Characteristics (Description)



A fish pond is a shallow body of water, used for the controlled farming of fish. It is adapted to be easily and completely drained. It includes:

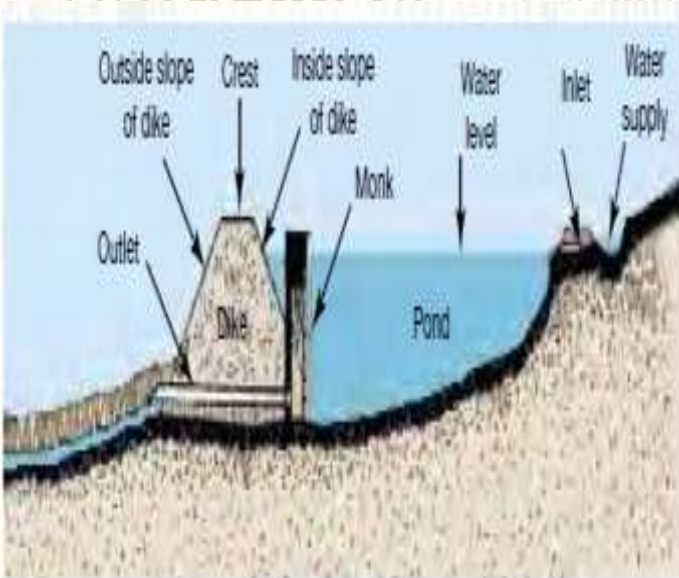
- ❖ A **plate** that forms the bottom of the pond.
- ❖ **Dikes**, which surround the pond and form walls that contain the water. These walls must be solid, to resist water pressure, and impermeable.
- ❖ An **intake** structure that collects water to fill the pond.
- ❖ The **emissary**, a river or canal that allows for drainage.
- ❖ Canals that bring or evacuate pond water:
 - ❖ The **supply canal** or **water inlet** brings collected water to the pond.
 - ❖ The **draining canal** or **evacuation** allows drainage toward the emissary.

Pond Characteristics (Description)



- ❖ **Regulation** devices control the water's level, flow, or both:
 - ❖ The **water inlet** is the device that regulates water flowing toward the pond and stops water from flooding.
 - ❖ The **water outlet**, preferably a monk, controls the water level and evacuation of the pond.
- ❖ The **outfall** or **overflow** allows evacuation of excess water, ensuring safety.
- ❖ **Filters**, if necessary, prevent animals and particles from entering or exiting the pond
- ❖ A **fence** surrounds the pond and keeps undesirable visitors out.
- ❖ Other **structures provide protection** against fish-eating birds, if necessary.
- ❖ **Access ways** and **roads** surround the pond and allow people to reach it.

Pond Characteristics (Types of Ponds)



- ❖ Piscicultural fresh water ponds differ by the origin of their water supply, their drainage method, construction materials and processes, and, finally, fish farming methods. These characteristics are usually determined by the characteristics of the site where they are built.
- ❖ Ponds can be classified according to:
 - ❖ Water supply.
 - ❖ Drainage systems.
 - ❖ Building materials.
 - ❖ Use of the pond.
- ❖ Concerning the utilization of a pond, the same pond can serve different purposes, depending on the specific moment and the evolution of the installation.

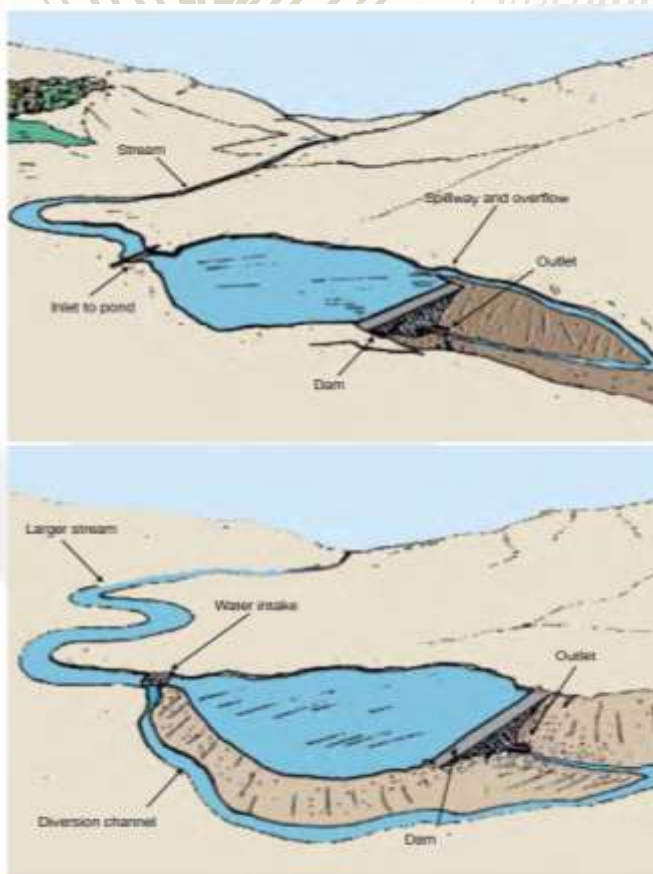
Pond Characteristics (Types of Ponds)

One will find:

- ❖ **Spawning** ponds for production of eggs and small fry;
- ❖ **Nursery** ponds for production of larger juveniles;
- ❖ **Brood** ponds for rearing broodstock;
- ❖ **Storage** ponds for holding fish temporarily, often before they are sold;
- ❖ **Fattening** ponds, for the production of fish that will be consumed;
- ❖ **Integrated** ponds that include crops, animals or other fish ponds, which supply waste materials that act as feed or fertilizer for the pond; This presentation will only provide information on ponds that are viable and appropriate for subsistence fish farming. The principal characteristic will be that they can be completely drained, and have **running water available year-round**. We will not consider ponds collinaires supplied with streaming or rain water, or resurgent ponds that are supplied with ground water. We will focus on two types of river-fed ponds:
 - ❖ **Barrage** ponds.
 - ❖ **Diversion** ponds.

Pond Characteristics

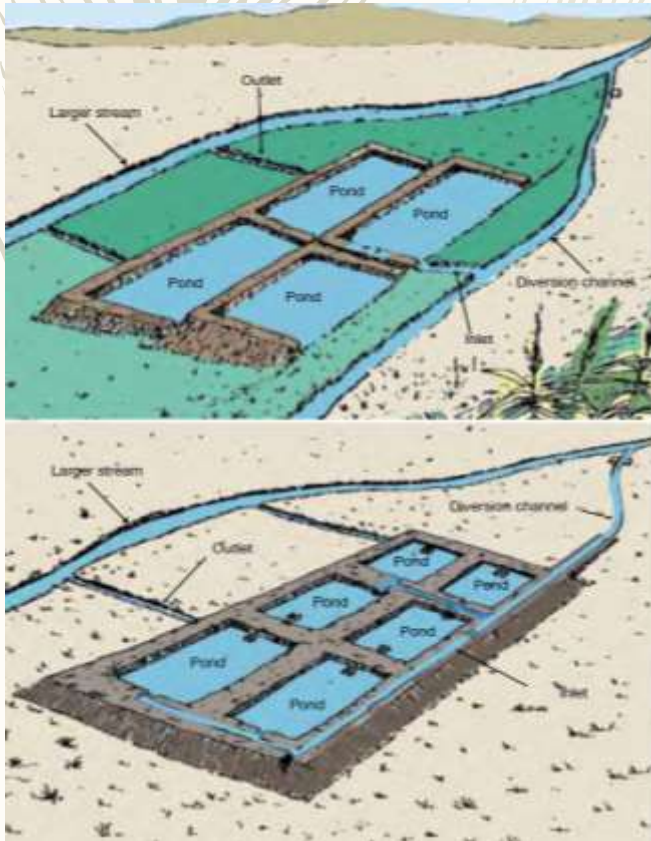
(Types of Ponds - Barrage)



- ❖ In barrage ponds, all the water coming from the source passes through. A small river can be blocked so that water retained by the dam makes a pond. A monk is installed in front of the dam to drain the pond. One or more spillways are expected to drain excess water in case of floods or heavy rains. The spillways must be able to evacuate even in the worst flooding; if not the entire dam may be carried away.
- ❖ The most important thing to know before beginning construction of a barrage pond is the river's maximum level and maximum discharge during the rainy season, after a heavy rain. On big rivers, which get much higher during the rainy season, it is better to build diversion ponds. In addition to this lack of control over the flow of water entering the pond, it is impossible to stop fish that live upstream from entering the pond.
- ❖ Nets cannot be put on the spillways to prevent fish from escaping when the spillways works. Nets may be blocked by leaves, branches and mud suspended in the water. The water will rise and may break the dike.
- ❖ One cannot correctly control the amount of water in the pond, so there is a significant risk of flooding (which will cause the loss of fish, food and fertilizer when the river flows high).

Pond Characteristics

(Types of Ponds - Diversion)



- ❖ Unlike barrage ponds, which retain all of the water from the stream, diversion ponds use only some of the water. In these ponds, only a portion of the water passes through from the source, rather than all of it. The entry and exit of water from the pond are controlled.
- ❖ Thus, part of the stream diverges into a supply canal that brings water to the ponds. Intake to the stream is usually built in front of a small deviation dam. This dam ensures that a constant water level is maintained in the supply canal. All of the surplus water that is not needed passes through the dam's spillway.
- ❖ Ponds that have a diversion canal can be built parallel or in a series.
- ❖ Diversion ponds, which are derived from bypass ponds, are built on the slopes of a valley and are primarily composed of three dams. These ponds are generally inexpensive, have a low flood risk, and drain well.

Pond Characteristics (Types of Ponds - Comparison)

Type	Advantages	Disadvantages
Barrage pond*	<ul style="list-style-type: none"> • Simple to design for small stream. • Construction costs relatively low unless there are flood defence problems. • Natural productivity can be high, according to quality of water supply. 	<ul style="list-style-type: none"> • Dikes need to be carefully anchored because the risk of break down in case of flooding. • Need for a spillway and its drainage which be costly. • No control of incoming water supply (quantity, quality, wild fish). • Cannot be completely drained except when incoming water supply dries out. • Pond management difficult (fertilization, feeding) as water supply is variable. • Irregular shape and size. • Sociological problems due to possible water retention towards the people living downstream.
Diversion pond**	<ul style="list-style-type: none"> • Easy control of water supply. • Good pond management possible. • Construction costs higher on flat ground. • Can be completely drained. • Regular pond shape and size possible. 	<ul style="list-style-type: none"> • Construction costs higher than barrage ponds. • Natural productivity lower, especially if built in infertile soil. • Construction requires good topographical surveys and detailed staking out.

* If the barrage pond is built with a diversion channel, some of the disadvantages may be eliminated (controlled water supply, no spillway, complete drainage, easier pond management), but construction costs can greatly increase if the diversion of a large water flow has to be planned.

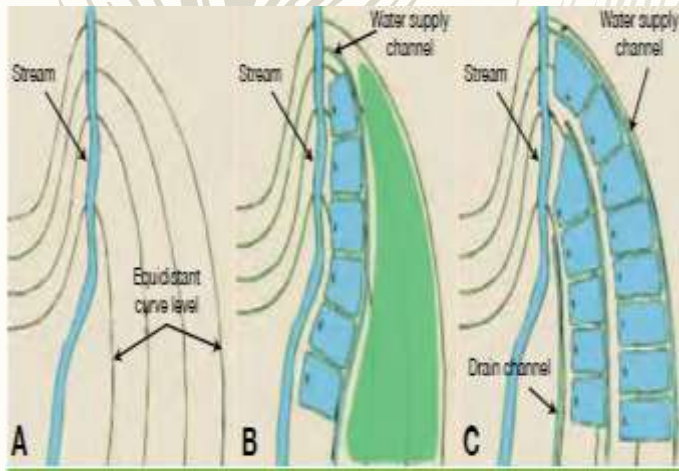
** Relative advantages will vary according to the arrangement of the ponds, either in series (pond management is more difficult) or in parallel (both water supply and drainage are independent, which simplifies management).

It is important to remember the following points:

- ❖ If the water supply is well controlled, ponds will be easier to manage when you are, for example, fertilizing the water or feeding the fish.
- ❖ Better drainage also makes the pond easier to manage during tasks such as harvesting farmed fish and preparing and drying the pond bottom.
- ❖ Ponds with a regular shape and correct size are easier to manage and adapt to specific purposes.
- ❖ The choice of a particular type of pond will largely depend on the available water supply and the topography of the site selected. Practically, although it costs more, the increasingly intensive integrated management of fish production will be easier with diversion ponds.
- ❖ Moreover, it is not possible to increase the number of ponds in barrage pond systems. This is important because avoiding the use of barrage ponds will eliminate the need to block water from rivers that is also used by villages located downstream, thus avoiding possibly violent conflict.

Pond Characteristics

(Types of Ponds – General Criteria)



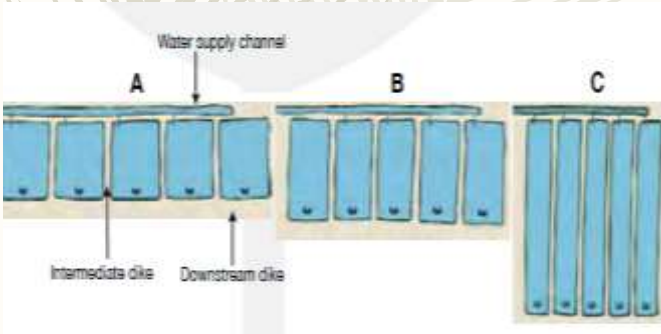
- ❖ Depending on the need, it will be possible to build a series of ponds managed by shifted sowing, which allows for regular monthly harvests throughout the year.
- ❖ Following the goal of limiting work and costs while optimizing the availability of water, basins should be laid out to align with the topography. Thus, development of a suitable site is a complex exercise.
- ❖ Building terraces makes it possible to have a larger surface area, and water will be retained better. Downstream dikes should be positioned across the flow of water in the basin in order to make more water available for storage at the site.
- ❖ An overall design for the site, is essential to utilize the surface, the difference between the intake and draining areas and the availability of water as well as possible. Arrangement of the pond in the course of the water will not increase the suitable surface (B): as the surface in green is not utilized.
- ❖ This flow is parallel to the water course. On the other hand, in the diagram (C), water flowing perpendicular to the water course is blocked since all the ponds are on the same level. More water will then be stored in the basement above the level of the ponds, and will be available to fill the ponds again or to limit loss during the dry season.

Pond Characteristics (Pond Shapes)

Pond shape	Width (m)	Length (m)	Dike length (m)
square	10	10	$20 + 20 = 40$
rectangular	7	14.3	$14 + 28.6 = 42.6$
	5	20	$10 + 40 = 50$
	2	50	$4 + 100 = 104$

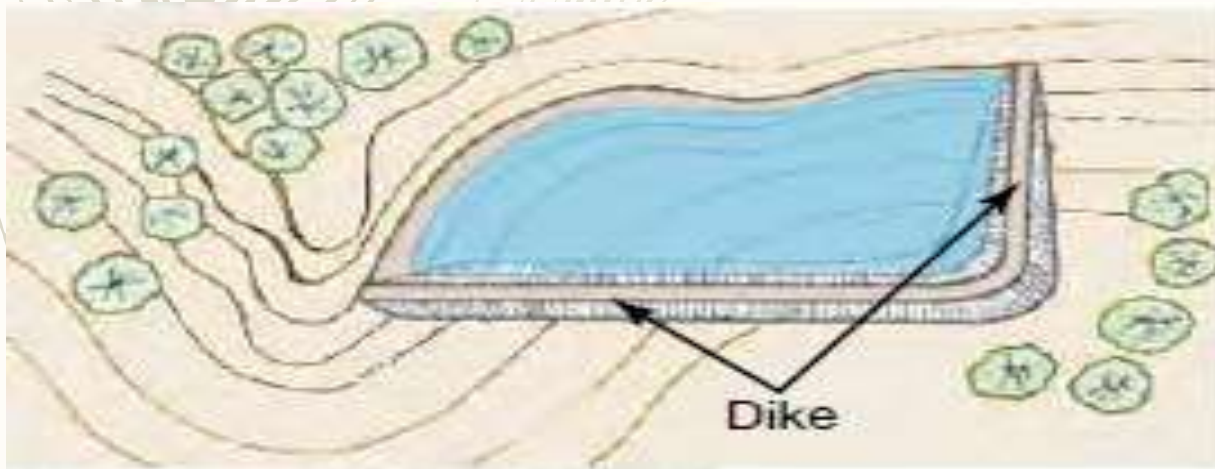
❖ For an even water surface, the pond should be shaped in a way that minimizes the overall length of the dam. For a pond of a given dimension, the overall length of the dike increases as the pond's shape deviates gradually from a square and becomes more elongated.

❖ At the same time, construction costs increase. The dikes that separate the ponds (intermediate dikes) are narrower than the downstream-dike. The square form extends the downstream-dike (A). If the rectangular form is too elongated, it will be reduced, but will considerably elongate the intermediate dikes (C).



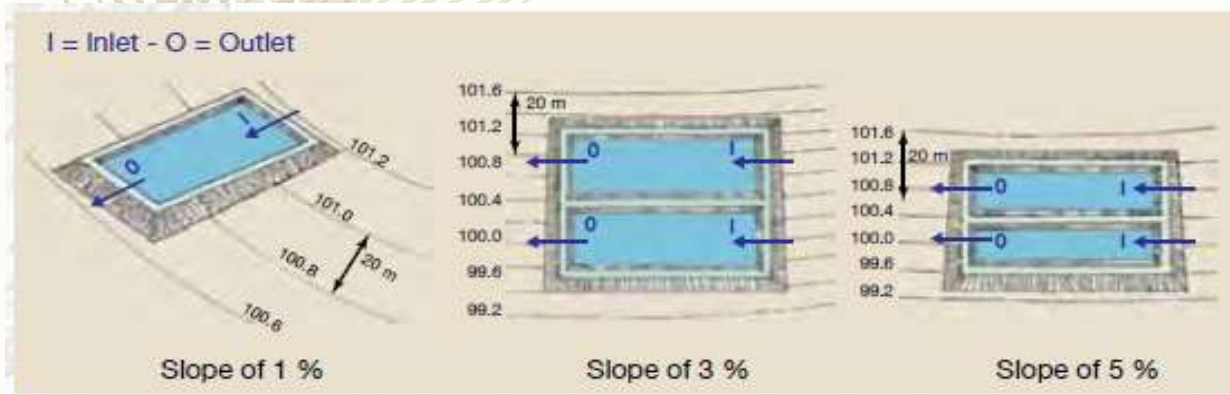
❖ Moreover, in order to maintain the slope and guarantee that it drains adequately, it will be necessary to dig more deeply. These two forms (A and C) are not optimal. On regular ground, the pond shape that requires the least work is rectangular but not too elongated (B). This is the preferential form. In general, rectangular ponds are twice as long as they are wide. It is, also, better to use a standard width for ponds designed for the same use.

Pond Characteristics (Pond Shapes)

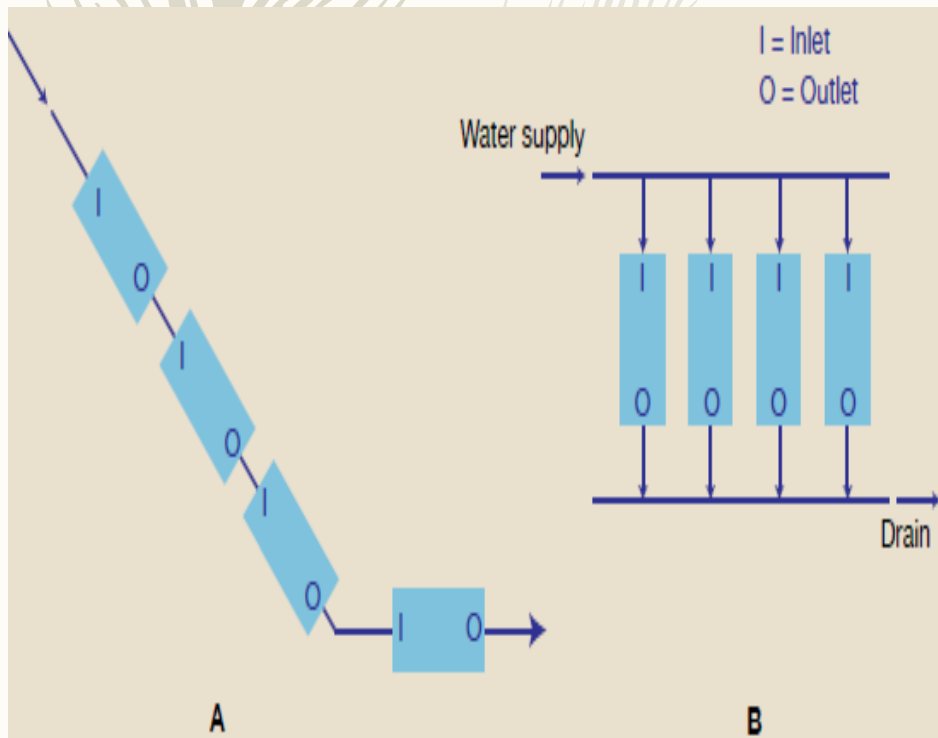


In some cases, it may be easier and more economical to adapt the shape of the pond to existing topography. The orientation of the ponds will vary depending on the angle of the slope, but should minimize excavation.

- ❖ **Slopes of 0.5 to 1.5%:** The long side of a rectangular pond must be perpendicular to the level lines. This means that ponds must be oriented in the direction of the bottom of the slope, following the natural slope. It is not necessary to dig in the section that is deepest.
- ❖ **Slope greater than 1.5%:** The long side of a rectangular pond should be parallel to the level lines, so the pond must be perpendicular to the slope. The more the slope increases, the smaller the ponds should be.



Pond Characteristics (Pond Layouts)



When several ponds are being installed, they can be positioned in two ways:

- ❖ **In a Series (Photo A opposite):** The ponds depend on each other for their water supply, as the water runs from the upper ponds to the lower ponds. This system has the advantage of limiting the number of draining and supply canals. However, since the same water is flowing through all of the ponds, a pond is contaminated, there is a higher risk that the others will become contaminated and all production will be lost. Draining the ponds will also be a problem. This layout also requires a steeper slope.
- ❖ **In Parallel (Photo B opposite):** Ponds are independent from each other, and each gets its supply of water directly from the supply canal. Water is not re-used after flowing through one pond. Unlike ponds in a series, each of these ponds can be isolated, and limiting the risk of contamination. Each pond is drained independently and the slope is the same for each.

Pond Characteristics (Pond Sizes)

Type of fishfarming	Area (m ²)
Subsistence	100 - 400
Small-scale commercial	400 - 1000
Large-scale commercial	1000 - 5000

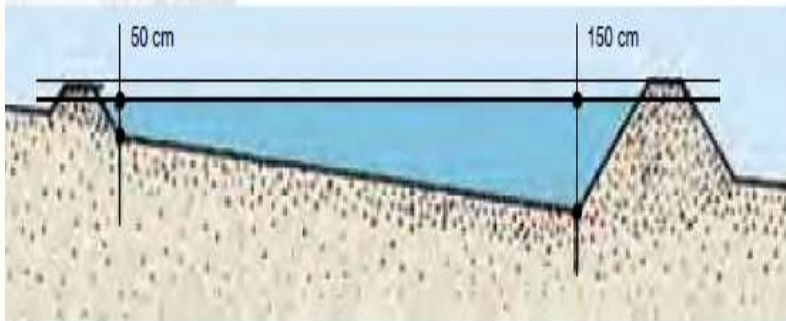
	Small pond	Large pond
Water	Small quantity	Large quantity
	Rapid filling/draining	Slow filling/draining
Fish seed	Small number	Large number
Fertilizer / feed	Small amount	Large amount
Fish marketing	Small harvest	Large harvest
	Local markets	Town markets

Ponds are characterized by their size, their form and their depth. The farmer can decide upon the individual size of sunken ponds and diversion ponds, as long as he considers the following factors:

- ❖ **Use:** A spawning pond is smaller than a nursery pond, which is in turn smaller than a fattening pond.
- ❖ **Quantity of fish to be produced:** A subsistence pond is smaller than a small-scale commercial pond, which is in turn smaller than a large-scale commercial pond.
- ❖ **Level of management:** An intensive pond is smaller than a semi-intensive pond, which is in turn smaller than an extensive pond.
- ❖ **Availability of resources:** There is no point in building large ponds if there are not enough resources to supply them, including water, seed fish, fertilizers and/or feed.
- ❖ **Size of harvests and local market demand:** Large ponds, even if only partially harvested, may supply too many fish for the local market.
- ❖ **Ponds for production fish farming should have a maximum surface area of 400 m².**

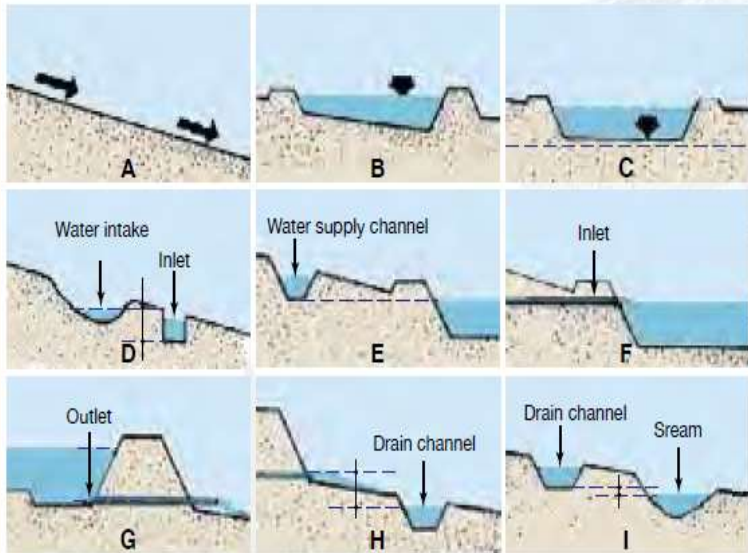
Pond Characteristics (Pond Depths)

Shallow ponds	Deep ponds
Water warms up rapidly	Water temperature more stable
Substantial temperature fluctuation	Less natural food available
Greater danger from predatory birds	Difficult to capture fish in deep water
Greater growth of water plants	Strong, high dikes needed
Smaller dikes needed	



- ❖ Fish ponds are generally not very deep; their maximum depth does not exceed 1.50m.
- ❖ The shallowest part should be at least 0.50m in order to limit the growth of aquatic plants.
- ❖ Deeper ponds are much more expensive to construct because the volume of the dams increases quickly with the depth of the pond.
- ❖ However, it is sometimes necessary to use deeper ponds. In dry areas, it is essential to store enough water for the dry season.

Pond Characteristics (Pond Depths)

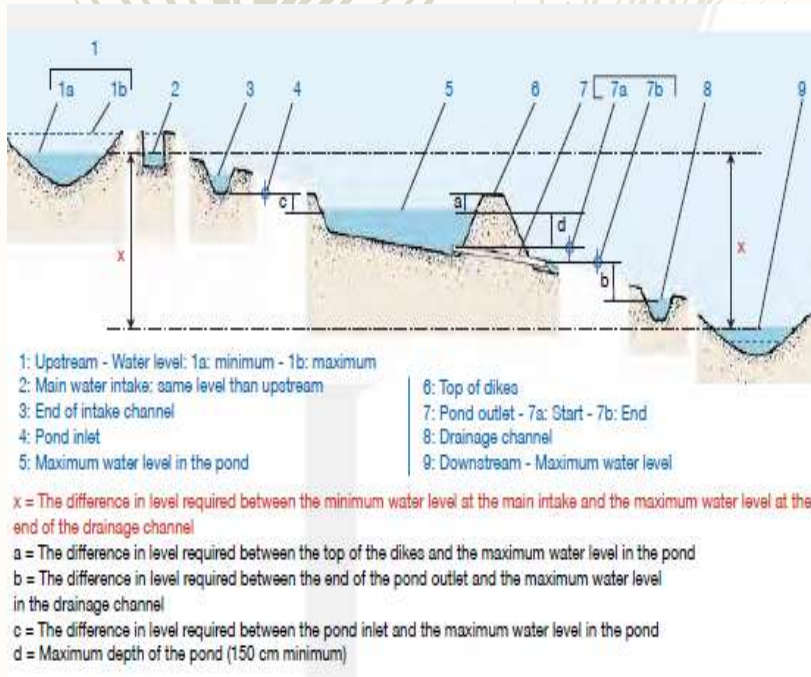


Differences in levels

In all cases, there are specific rules for constructing easily managed, completely drainable ponds that are filled using gravity (Figure 46, p. 72).

- ❖ Water flows down from the highest to the lowest point (A).
- ❖ The water surface in a pond is always horizontal, even if the ground below it is not (B).
- ❖ The bottom of the pond should be above the water table when the fish are harvested (C).
- ❖ The bottom of the main water intake should be below the minimum level of the water source (D).
- ❖ The bottom of the feeder canal should be at or above the pond's maximum water level (E).
- ❖ The pond inlet should be located at or above the pond's maximum water level (F).
- ❖ The beginning of the pond outlet should be at the lowest point of the pond (G).
- ❖ The end of the pond outlet should be at or above the water level in the drain (H).
- ❖ The end of the drain should be at or above the maximum water level in the natural riverbed (I).

Pond Characteristics (Pond Depths)

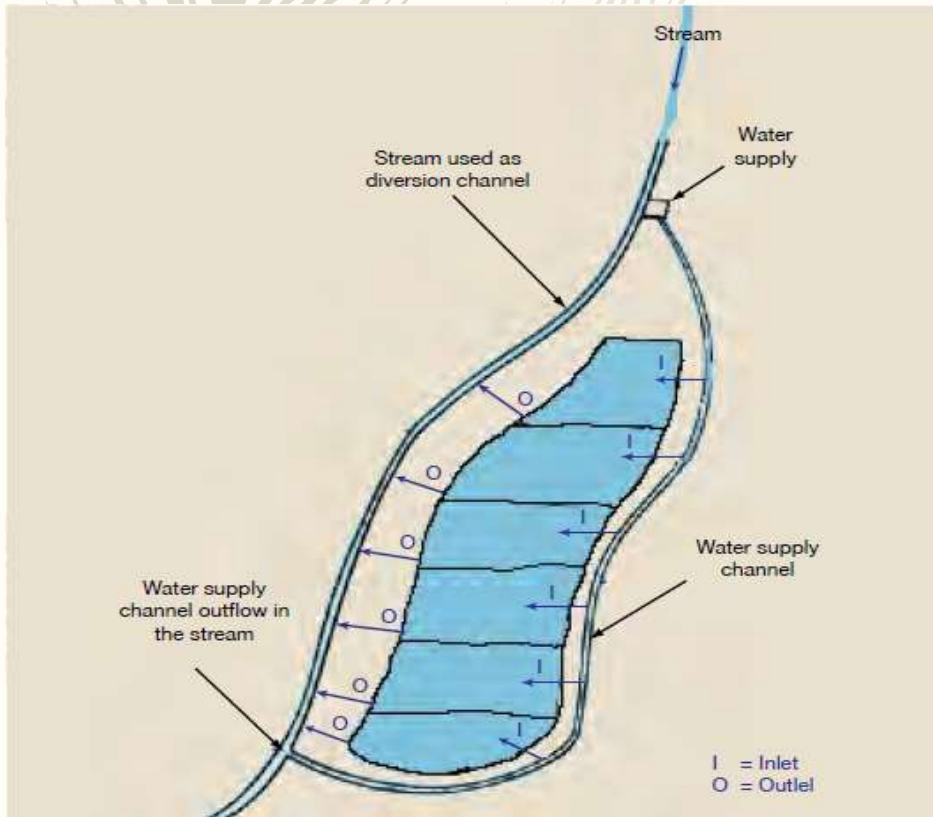


- ❖ For a diversion pond that is being filled from a stream through a main water intake and a feeder canal, it is easy to determine the difference (x) (cm) required between the minimum water level at the main intake and the maximum water level at the end of the drain. As an example, consider a pond with a depth of 150 cm. Add the difference in levels necessary between the outlet of the pond's drainage device and the maximum water level in the drainage canal (b), and the difference in level between the pond's water supply canal and the pond's maximum water level (c), as well as the value between the entry and the exit of the pond's drainage device (e).

$$x > 150 + b + c + e$$

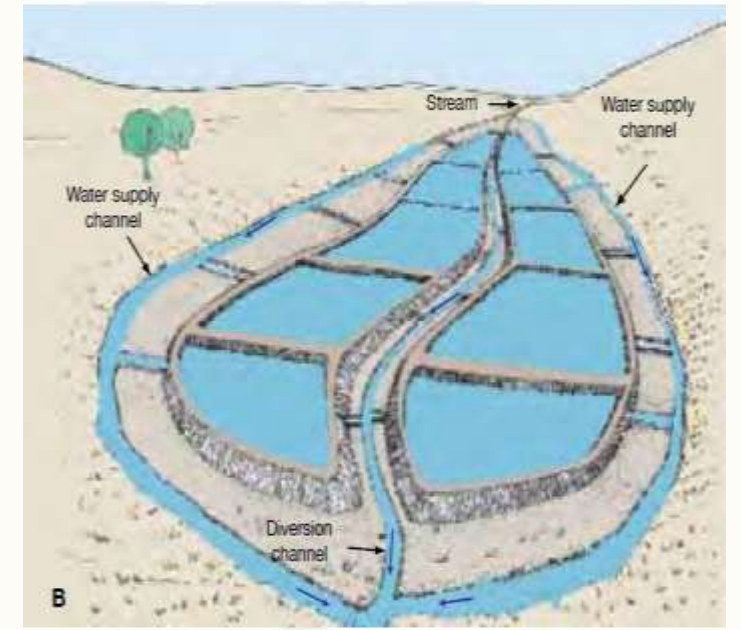
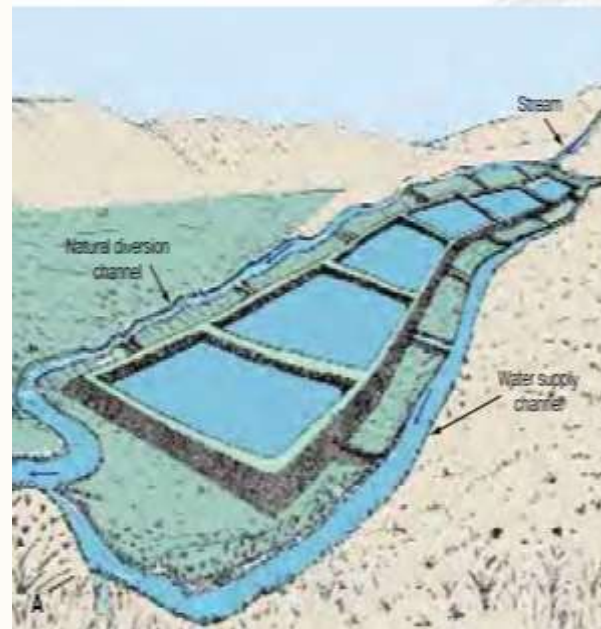
- ❖ It is essential to reach this minimum difference in levels if the pond is going to be completely drainable.

Pond Characteristics (Summary)



Classic plan for diversion ponds

- ❖ In a classic plan for diversion ponds, the ponds will thus be laid out in a pattern similar to the ones depicted on this slide:



Pond Management

- ❖ We hope this presentation has given you an insight into the characteristics of a pond before you construct your ponds to go into the business of fish farming.
- ❖ In case you need more information, please feel free to post your questions on the blog so that we can help you with the required recommendations and solutions. Noting that the more information you have the more successful you are as a fish farmer.

