Fish Culture Engineering
3- Ponds

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Introduction

Earthen ponds are the most used unit for fish Production worldwide, and more than 40% of world aquaculture production is performed in ponds

Important species grown in ponds, include different types of carp, catfish, shrimps and prawns

Ponds are normally used in extensive production and to some extent in more intensive production

An earth pond for aquaculture farming is usually defined as a pond where a natural ecosystem is created inside

This is the major difference between earth ponds and other closed production units, and the reason why they are described separately

The water exchange in the pond is normally very small and it will also function as a settling pond, so faeces and particles will settle on the bottom

Inside the pond there can be a monoculture or polyculture. If using a polyculture, the natural food created in the pond (**phytoplankton, zooplankton, aquatic insects, benthic organisms and the vegetation**) can be utilized optimally by different species.

The ecosystem

An established ecosystem in the pond includes full algal photosynthesis. During the day the algae produce oxygen by photosynthesis, while during the night they consume oxygen.

Thus there will be a daily fluctuation in the oxygen level in the pond, and special care must be taken during the night when it may be necessary to supply additional oxygen

Similarly, the pH may fluctuate because photosynthesis fixes carbon dioxide and therefore the pH will increase during the daytime, while at night the algae release carbon dioxide and the pH will drop.

A major benefit of a pond is therefore that it is possible to utilize this biological production, which includes prey that is food for the fish. In addition, there will also be decomposition of waste

However, to achieve this state the water exchange rate must not be too high

The major disadvantages with production in ponds is the low production per unit volume, and the difficulties of maintaining control over the water quality and the actual fish biomass.

the winter (rainbow trout). Warm groundwater is utilized in the winter season to keep the pond free from ice

Ponds for on-growing production during (the summer (catfish)

Empty ponds reveal the construction more clearly.

Different production ponds

Ponds can be separated into those for fry production and those for on-growing production, the difference is normally the size of the ponds

However, full production ponds are also possible. In such ponds, spawning, fry production and on-growing all occur, although harvesting can be quite difficult

In a pond for fry production, it is especially important to have a well functioning ecosystem, including photosynthesis

Eggs or newly hatched fry
are released into the pond where the on-going ecosystem will produce natural prey for the fry

As the fry grow they will gradually feed on other prey that are also available in the pond. Depending on the desired production, additional feeding of the fry may not be necessary

To stimulate and increase the development of the natural ecosystem, it is possible to fertilize the pond

This increases production of algae and hence production of higher organisms that function as natural prey for the growing fry

It is easy to lose control of the ecosystem, and total breakdown may occur. If fertilizing, it is therefore of major importance regularly to monitor and control changes in the water quality, for instance by monitoring the oxygen content in the pond water

In on-growing ponds, there is often some type of additional feeding, but this depends on the species

Some species will utilize the plants growing in the pond and the organism created by the ecosystem, but this is normally not enough if high production is wanted; an example here is grass carp

Other species may only use supplied artificial feed, such as catfish and rainbow trout

In **on-growing ponds**
it is easy to overload the system when adding formulated feed and cause problems in the ecosystem which will be put out of balance so that the pond functions in an uneconomic way

The water flow through a pond having a natural ecosystem must not be too high, otherwise algae and natural prey may flow out with the outlet water, and an imbalance in the ecosystem will occur

Pond types

There are several ways to classify ponds: one is based on construction and another on whether it is possible to drain the pond or not.

Drainable or non-drainable

Depending on the construction of the outlet system, traditional earth ponds can be divided into drainable and non-drainable ponds

Nondrainable ponds are normally larger, up to several hectares. Small natural lakes used for aquaculture production function like a non-drainable pond

Low establishment cost is the main advantage with non-drainable ponds. Natural lakes can also be used and create a low cost farming volume

The advantage with drainable ponds is the possibility for a more effective harvesting process and to have control over the water level, because the water can be drained out of the pond

It is simpler to fertilize/
feed, and also to supply additional air. While non-drainable ponds are normally run extensively, drainable ponds can be run more intensively, depending on the amount and growth rate of the Fish

In intensive drifted ponds the fish can be fed and additional air supplied periodically.

Feeding from a tractor-trailer with a feed blower to increase production in the pond

In ponds the production is given in kg per hectare of pond surface area. This varies with water temperature, environmental conditions, pond type and the fish species, so it is difficult to give a general value

A rough estimate is 1000 kg/ha, but this can vary too much: over 15000 kg/ha can be achieved for channel catfish by use of additional feeding and continuous aeration

Size and construction

The size of the pond varies with species, fish size and site conditions, from fractions of a hectare to several hectares

A major pump type is the displacement pump in which liquid is displaced from one area to another

As the ponds become larger, control becomes more difficult. The same is the case with harvesting.

To carry out the harvesting the pond must normally be emptied and/or drained several times, otherwise the fish density will be too high when lowering the water level and harvesting. A seine net may also be used for harvesting

Commonly, relatively small ponds are used for brood stock, fry and juvenile production, while larger ponds are used for on-growing

Pond depth is usually between 0.5 and 2.4m, depending on what the pond is used for

For on-growing fish it is normal to choose a depth sufficient to prevent any light reaching the bottom of the pond. In this way growth of vegetation at the bottom is prevented and harvesting is easier

Ponds for fry are normally shallower because the bottom vegetation may function as shelter. However, the depth must not be so great that temperature layers occur

It is important to have a slope towards the outlet on the bottom to make drainage possible and harvesting easier
: this can be in the range 1/1000 to 1/100, with the largest slope in the smallest ponds

Site selection

Ponds should be as close to the water source as possible, to avoid long inlet pipes or channels

In addition, there must be enough clay in the earth to prevent leakage

If the material contains too much sand,
will be porous and water will drain out much faster

The seepage
loss in sand is reported to be between 25 and 250mm/day, in loam 8–20mm/day and in clay 1.25–10mm/day

Furthermore, the earth must be
free of toxic substances, for instance copper

There are several methods to prevent leakage from ponds. If the leakage is only slight, a solution is to break down the earth structure, reduce the aggregate size and puddle the bottom

If the natural soil is unsuitable,
a membrane of clay or plastic may be used

A clay layer transported to the site must be about 30cm thick for a 3m deep pond

This, however,
represents increased costs for establishing the pond

The inlet

The water can either be supplied by a pump or under gravity; the latter is the best solution. Seawater ponds may be filled at high tide

Channels or pipes can be used to distribute the water from the source to the ponds. If channels are used, gravity flow is necessary. If pumps are used they must eventually lift the water from the source into the distribution channel

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The Outlet

How the outlet is constructed depends on whether or not there is a collection basin for the fish, and if this is inside or outside the pond.

The design of the level control will also influence the construction of the outlet system. If open channels are used, there are separate ones for the outlet water and level control

Normally a standpipe inside the pond functions as a level control. The water has to pass through this standpipe, which may be variable or fixed, to flow out of the pond

Outlet and inlet construction of a pond