Fish farming, Water quality in fish Farming and Pond Maintenance

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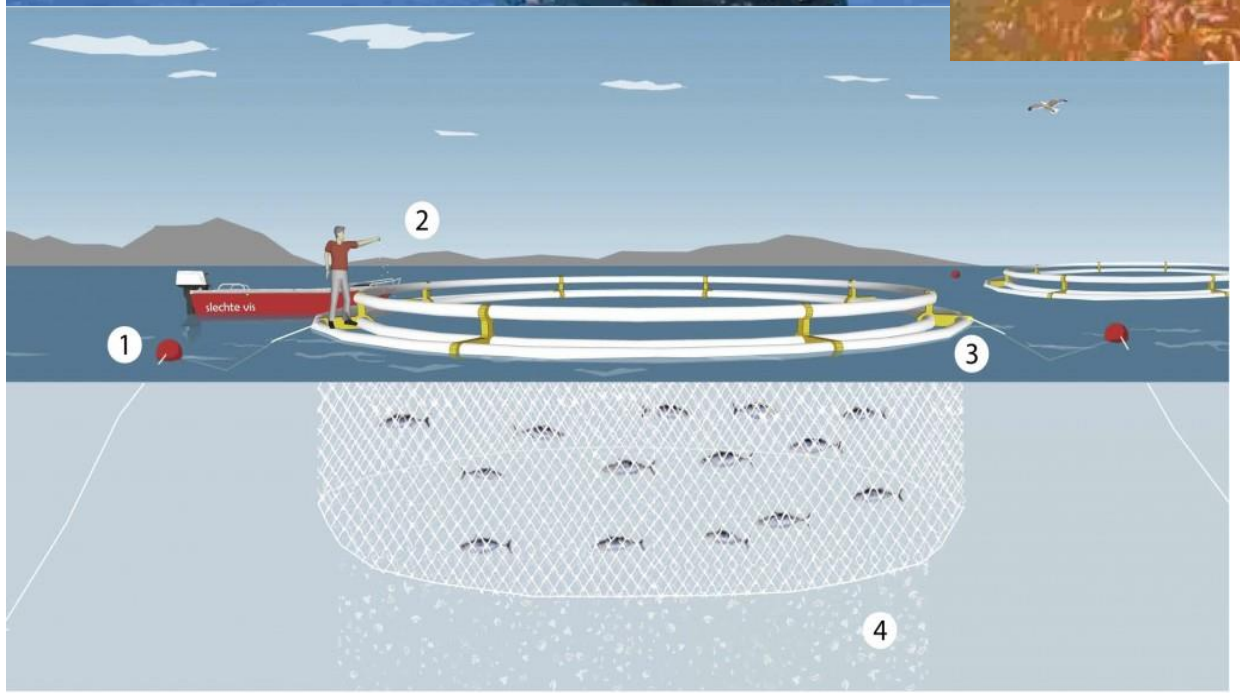
- **Fish farming** or **pisciculture** involves raising fish commercially in tanks or enclosures such as fish ponds, usually for food. It is the principal form of aquaculture, while other methods may fall under mariculture. A facility that releases juvenile fish into the wild for recreational fishing or to supplement a species' natural numbers is generally referred to as a fish hatchery. Worldwide, the most important fish species produced in fish farming are carp, tilapia, salmon, and catfish.
- Demand is increasing for fish and fish protein, which has resulted in widespread overfishing in wild fisheries. China provides 62% of the world's farmed fish. As of 2016, more than 50% of seafood was produced by aquaculture.
- Farming carnivorous fish, such as salmon, does not always reduce pressure on wild fisheries. Carnivorous farmed fish are usually fed fishmeal and fish oil extracted from wild forage fish. The 2008 global returns for fish farming recorded by the FAO totaled 33.8 million tonnes worth about $US 60 billion.

Fish farms

- **Cage system**
- The method is also called "off-shore cultivation" when the cages are placed in the sea. They can be constructed of a wide variety of components. Fish are stocked in cages, artificially fed, and harvested when they reach market size. A few advantages of fish farming with cages are that many types of waters can be used (rivers, lakes, filled quarries, etc.), many types of fish can be raised, and fish farming can co-exist with sport fishing and other water uses.
- **Irrigation ditch or pond systems**

  These use irrigation ditches or farm ponds to raise fish. The basic requirement is to have a ditch or pond that retains water, possibly with an above-ground irrigation system (many irrigation systems use buried pipes with headers.)

  Using this method, water allotments can be stored in ponds or ditches, usually lined with bentonite clay. In small systems, the fish are often fed commercial fish food, and their waste products can help fertilize the fields. In larger ponds, the pond grows water plants and algae as fish food. Some of the most successful ponds grow introduced strains of plants, as well as introduced strains of fish.



1. The cage is moored to the ocean floor 2. Fishemeal based feeds are added to the cages 3. Buoyant tubes keep the cages afloat 4. Fish faeces and waste fall through the cages

- **Composite fish culture** The composite fish culture system is a technology developed in India by the Indian Council of Agricultural Research in the 1970s. In this system, of both local and imported fish, a combination of five or six fish species is used in a single fish pond. These species are selected so that they do not compete for food among them by having different types of food habitats. As a result, the food available in all the parts of the pond is used. Fish used in this system include catla and silver carp which are surface feeders, rohu, a column feeder, and mrigal and common carp, which are bottom feeders. Other fish also feed on the excreta of the common carp, and this helps contribute to the efficiency of the system which in optimal conditions produces 3000–6000 kg of fish per hectare per year.

Composite Fish Growing.

Water quality in fish Farming

- Water quality for aquaculturists refers to the quality of water that enables successful propagation of the desired organisms
- The required water quality is determined by the specific organisms to be cultured and has many components that are interwoven. Growth and survival, which together determine the ultimate yield, are influenced by a number of ecological parameters and managerial practices. High stocking density of fish or crustaceans in ponds usually exacerbates problems with water quality and sediment deterioration.
- There is a strong relationship between the quality of the water in the pond and that in the water surrounding environment. Degradation of surrounding water quality will be faster unless proper water quality management techniques are not implemented in the ever increasing aquaculture system.

Aquaculture pond dynamics

Aquaculture ponds are a living dynamic systems they exhibits continuous and constant fluctuations. The pond undergoes a vast collection of both chemical reactions and physical changes. Exchange of atmospheric gases including Oxygen (O_2), nitrogen (N_2) and Carbon dioxide (CO_2) with the pond water are vital to the process of fish metabolism and plant photosynthesis. Inorganic substances (minerals) dissolve from the pond walls and bottom while precipitation of dissolved minerals occurs. Physicals exchanges between the pond its surroundings include absorption of sunlight (radiant energy) to fuel photosynthesis and supply oxygen with in the pond, heat exchange and volume changes caused by evaporation and precipitation (rain). Changes in the volume of a pond are very important as they affect the concentration of dissolved substances and correspondingly requirements for treatment. Hence, the pond dynamics not only depend on its own characters and conditions but also on the surrounding atmospheric weather conditions. Good production from aquaculture ponds can be achieved when the pond and surroundings make chemical and physical exchanges at a steady state. When all of the processes balance, a state of equilibrium is achieved. Pond equilibrium is the optimum set of conditions for aquaculture, a state completely in harmony with nature.

Water chemistry

Water may be considered as a ‘binder’ or ‘matrix’ in which the dissolved gases, inorganic substances (minerals), as well as organic matter prevails. In addition to dissolved substance, the water matrix gives support to microorganisms, plant and animal life forms and provides a medium for chemical exchange among these populations.

- The maintenance of good water quality is essential for both survival and optimum growth of culture organisms.
- The culture organisms, algae and microorganisms such as bacteria produce metabolites in a pond. The major source of nutrients in aquaculture is the feed. Because large quantities of feed are loaded in ponds, excess feed, fecal matter and other metabolites become available in large quantities for the growth of algae and microorganisms.
- By realizing the overriding significance of water chemistry, it is important to have a firm grasp of some basic concepts. Like: (Temperature, DO, pH and turbidity etc)

1. **Temperature:** Aquaculture organisms are cold-blooded animals. They can modify their body temperature to the environment in normal condition, unlike the warm-blooded animals, For eg. the optimum range of temperature for the Black Tiger shrimp is between 28°C-30°C. Increase in temperature beyond 30°C increases the activity level and the metabolism. This also increases the growth rate

- If the temperature falls below 28°C, the metabolism reduces and so does the active behaviour and growth rate. Below 20°C, the shrimp will take less feed. Shrimps cannot tolerate a temperature less than 13°C.

2. **Dissolved Oxygen:** Typically, dissolved oxygen is measured either in mg. per litre (mgl-) or parts per million (ppm) with O ppm representing total oxygen depletion and 15 ppm representing the maximum or saturation concentration. Supplemental aeration is generally provided during nighttime when DO increases to levels below 4.0 ppm.

- It was also suggested that the low dissolved oxygen values in the aquaculture ponds be improved rapidly by combination of aeration and water exchange.

3. **pH (measure of acidity or alkalinity):** pH or the concentrations of hydrogen ions (H+) present in pond water is a measure of acidity or alkalinity. The pH scale extends from 0 to 14 with 0 being the most acidic and 14 the most alkaline. pH 7 is a condition of neutrality and routine aquaculture occurs in the range 7.0 to 9.0 (optimum is 7.5 to 8.5). Exceedingly alkaline water (greater than pH 9) is dangerous as ammonia toxicity increases rapidly. At higher temperatures fish are more sensitive to pH changes

- It is an important chemical parameter to consider because it affects the metabolism and other physiological processes of culture organisms. A certain range of pH (pH 6.8 – 8.7) should be maintained for acceptable growth and production

4. **Turbidity:** Water turbidity refers to the quantity of suspended material, which interferes with light penetration in the water column. In ponds, water turbidity can result from planktonic organisms or fro suspended clay particles. Turbidity limits light penetration, thereby limiting photosynthesis in the bottom layer. Higher turbidity can cause temperature and DO stratification in ponds.

Water quality parameters for shrimp farming

Water parameter	Optimum level
Temperature	26-33 C
Salinity	10-25 ppt
Dissolved oxygen	>3.0 ppm
pH	7.5-8.5
Total Ammonia Nitrogen	<1.0 ppm
Total Nitrate Nitrogen	<5.0 ppm
Nitrite Nitrogen	<0.01 ppm
Sulphide	<0.03 ppm
Biological Oxygen Demand	< 10 ppm
(BOD)	<70 ppm
Chemical Oxgen Demand (COD)	25-45 cm
Sacchi disc visibility	

Accessories in Farm management

- Mechanical Filtration
- Diffused Aeration
- Diffusers - air or oxygen
- Water Quality Testing
- Pumps
- Fish Transport
- Fish Feeders
- Scareheron
- Dip Nets

Aerator

- Paddlewheels are commonly used in semi-intensive fish culture and is one of the major capital cost item in the farm. The paddlewheel aerators are used to increase contact surface of water with air thereby increasing the area through which oxygen is absorbed by the water and to create a circular movement of the pond water.

This has the following advantages:

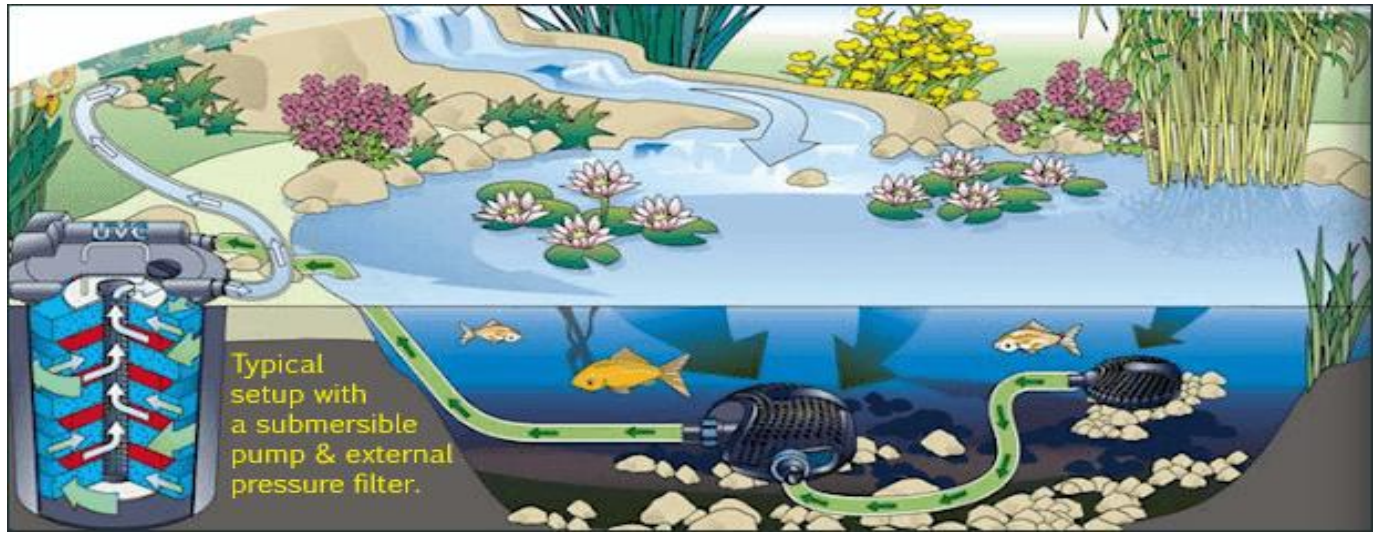
- It increases the dissolved oxygen level of the water and prevents oxygen depletion during the night.
- It accelerates the diffusion effect of not only the oxygen, but also enables the capture or release of carbon dioxide. Carbon dioxide is important for culture of algae and therefore for maintenance of appropriate watercolor.
- It facilitates the volatilization of undesirable gases such as N_2, NH_3, CH_4 and H_2S.
- It reduces the daily fluctuation range of pH value.
- It accelerates the decomposition and mineralization of organic matter in water and soil and helps in the release of nutritive value of fertilizers.

- It diminishes the possible stratification of pH, DO, salinity and temperature in the pond water.
- It helps in mixing the pond water a maintenance of ideal conditions all over the pond.
- It increases turbidity when necessary
- As the pond water moves in a circular fashion the pond bottom is cleaned and the waste matter gets accumulated in the center and the corners. By this method most of the pond bottom is kept clean.

- The arrangement of paddlewheels in the pond is done to maximize circulation efficiency and minimize dead corner areas. The arrangement of paddlewheels should be to ensure anticlockwise movement of water in the pond in the Northern Hemisphere and clockwise movement of water in the pond in the Southern Hemisphere.
- Aerators are usually arranged parallel along the banks and about 5 to 10 m distant from the dikes depending upon the pond size. Each paddle wheel should normally separated by a distance of 30 m and 50 m for optimum efficiency of the paddle wheel. Avoid relocating paddle wheels during culture

Filter

- A **filter** is a device or process that removes some unwanted components or features from water. Filtering is a class of water processing, the defining feature of filters being the complete or partial suppression of some aspect of the signal
- All ponds with fish will benefit from having a filter system installed. Filters generally have a maximum and minimum flow rate requirement. Goldfish ponds do fine when pumping the entire volume of the pond once every two hours and Koi fish ponds do better when turning the pond volume over once each hour. Greater flow is fine as long as it does not exceed your filter requirements. The following recommendations will work well for most ponds. When choosing a system for a large fish population or a pond for Koi you may want to look at the next size up



Types of media use for pond filter

1. Natural pond filters have been used from the very beginning. Having been discovered in ancient cities of Rome, Egypt, China, and Mesopotamia. The basic idea is to create a balanced ecosystem where the plants and fish support one another. Fish waste feeds the plants and the plants filter the water for the fish. A true diy pond filter that works.

2. Pond filter media is the key ingredient to pond filters. The media allows microorganisms to attach and live on the surface. Creating a slimy biofilm that helps filter your pond.

3. Various sizes of mesh bags to hold filter media for ponds. Most bags come with a drawstring and push button release for easy installation, and cleaning of filter media.