International Journal of Research in Science and Technology
Volume 8, Issue 2: April - June, 2021
ISSN 2394 - 9554

ASSESSMENT OF WATER QUALITY FOR POND FISH CULTURE, ITS CONTROL AND TREATMENT

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ABSTRACT
The Optimum fish production is totally dependent on the physical, chemical and biological qualities of water to most of the extent. The aquatic environment governs fish life; hence water quality should be suitable for fish culture. When environmental condition does not conform to optimal range for normal fish growth, then fish culture could be affected. As fishes are a cost-effective source of protein, it is very much needed to balance the environmental factors for their growth and development. The quality or standard of water is determined by various factors like - Temperature, pH, Salinity, Turbidity, Water hardness and color, Dissolved Oxygen (DO), Carbon dioxide, Biochemical Oxygen Demand (BOD), Alkalinity, Ammonia, Nitrite, Nitrate, Primary Productivity, Plankton Population etc. In this following review article, it has been tried to show the effect of these above-mentioned factors, which will be helpful for the farmers to be aware about the importance of water quality that affect the health of fish and are required in ideal amount to enhance the yield of fish, to satisfy the present day need of this world

Keywords*: Water parameters, Fish farming, Pond water quality, Fish health, stress.*

INTRODUCTION
Fish perform all their physiological activities like swimming, respiration, feeding, digestion, excretion, growth and development, reproduction and all their metabolic activities etc. in water, so, water is very essential for the culture of fish (Bronmark 2005). Water quality of a pond depends on various physical and chemical parameters of water, so that, it can be easily observed and corrected (Boyd 1990). Temperature, pH, Salinity, Turbidity, Alkalinity, Hardness and color, Dissolved oxygen (DO), Biochemical Oxygen Demand (BOD), Carbon dioxide, Ammonia, Nitrite, Nitrate, are the various parameters, which exert influence on fish production (Boyd 1990). For fish culture, each and every parameter has an ideal value (James 2000). Water quality is the primary factor for fish production and hence, ultimately result in maximum productivity with minimum expenses. Mostly fish culture is carried out in pond water worldwide, as pond water can be easily maintained by its parameters (Swann 1993). Poor water quality of the pond may lead to a low fish production and ultimately, leads to economic losses.

WATER PARAMETERS
Some of the parameters of water are listed below, to understand how they affect the pond fish health and development. These parameters have certain optimum values, which are required by the fish to sustain their lives in that water medium.

(i) TEMPERATURE
It is the measure of hotness or coldness in the body of a living organism, either in terrestrial or aquatic medium (Lucinda and Martin 1999). At temperature between 25°C to 32°C, warmwater fish growth prospers. In chemical and biological processes, temperature plays an important role. For every 10°C increase in temperature, the rate of chemical and biological reactions gets doubled. The amount of dissolved oxygen used at 30°C is twice than that of used at 20°C. So, the rate of chemical reaction also doubled at 30°C than 20°C. When temperature suddenly changes in pond water, fish get stressed or even die as they have poor tolerance level (Boyd and Lichtkoppler 1979)

(ii) SALINITY
It can be defined as the total concentration of all the dissolved ions present in a natural water body and is expressed in mg/L. The osmotic pressure of water is directly proportional to the salinity (Boyd and Lichtkoppler 1979). The growth and density of fish population depends on salinity (Jamabo 2008)

(iii) TURBIDITY AND COLOR
The turbidity is the ability of light to be scattered by the materials present in the water, when a light source is radiated through the water sample (Bhatnagar and Devi 2013). In fish pond it is resulted from the Plankton present in it (Boyd and Lichtkoppler 1979). It can be measured using Nephelometric Turbidity Units (NTU). Pollutants like pesticides, Fertilizers, some nutrients may get bonded with the suspended solids present in the

ISSN 2394 - 9554

water body and settle in the bottom sediments, where they may become concentrated and affect the water quality greatly.

Color of the water can be defined as the wavelengths of visible light, which is reflected by the object present in water (Bhatnagar and Devi 2013). Although, fishes are not affected directly by water color, but the light penetration is restricted and hence, the plant growth is reduced (Boyd and Lichtkoppler 1979)

(iv) DISSOLVED OXYGEN (DO)
The photosynthetic Planktons and the atmospheric air are the two-principal source of oxygen in the water (Bhatnagar and Devi 2013). As there is low solubility of oxygen in water, it is difficult for aquatic organisms to obtain oxygen. The solubility decreases with increase in the salinity, increase in temperature, low atmospheric pressure, high concentration of submerged plants, planktonic blooms and high humidity. When the amount of oxygen in water gets reduced, it leads to a number of issues like poor feeding of fish, starvation, reduced growth and eventually the fish die (Bhatnagar and Garg 2000).

(V) PH
It is the negative logarithm of hydrogen ion concentration (Bhatnagar and Devi 2013). pH is the measure of alkalinity or acidity of the water medium. The pH is usually measured by using the colorimetric test - the litmus paper changes its color with increase in acidic or basic/alkaline level. The concentration of carbon dioxide greatly affects the pH of natural water (Boyd 1979). At day time, the pH will increase, as algae and plants in water removes the carbon dioxide for photosynthesis. During night time, the Carbon dioxide accumulates from the respiration of plants, fish and other aquatic organisms, and hence, the pH will decrease. The pH ranges between 6.5 to 9.0 is optimum for most fish species (Boyd and Lichtkoppler 1979)

(vi) WATER HARDNESS
It is the measurement of Calcium and Magnesium present in an aquatic system. Both of these magnesium and calcium are very crucial for the formation of scales and bones (Bhatnagar and Devi 2013).

(vii) CARBON DIOXIDE (CO_2)
In nature, carbon dioxide is the chief source of carbon pathway. It is the highly soluble gas present in water. It can be present in the water bodies as bicarbonate (HCO_3) or as carbonate (CO_3) in bound or dissolved form in earth crust, coral reefs regions and in limestones (Bhatnagar and Devi 2013).

(viii) BIOCHEMICAL OXYGEN DEMAND (BOD)
It can be represented as the total amount of dissolved oxygen, which is consumed by the bacteria and other microorganisms for the decomposition of organic matters (biodegradation), such as the sewage and food particles present in the water body, at a specific temperature. The greater the amount of BOD in the pond, the more rapidly oxygen depletion will occur and due to lack of oxygen in the water, the fish will suffocate and eventually die (Bhatnagar and Devi 2013).

(ix) ALKALINITY
It is the measurement of the total concentration of bases, present in the water, which includes the carbonates, bicarbonates, phosphates, borates, dissolved magnesium, calcium and other compounds. A small amount of acid can cause a large change in the pH, when the alkalinity is low (Bhatnagar and Devi 2013).

(x) CALCIUM
It is the most important, divalent salt in pond fish culture water. It is generally present in soil as carbonates. Fish can absorb Calcium either from food or water (Bhatnagar and Devi 2013).

(xi) AMMONIA (NH_3)
It is the excretory product of fishes and bacterial decomposition of organic matters, in the form of feces, dead Planktons, sewages etc. The unionized and ionized forms are combinedly called as "total ammonia". The NH3 (unionized ammonia) is extremely toxic in nature, whereas the NH4+ (ionized ammonia) is not toxic (Bhatnagar and Devi 2013).

(xii) NITRITE (NO_2)
It is formed by the breakdown of ammonia. The aerobic *Nitrosomonas* bacteria helps in the conversion of the toxic ammonia into Nitrite, through the process of oxidation. It is toxic to the fish.

(xiii) NITRATE (NO_3)

ISSN 2394 - 9554

It is formed from Nitrite. The aerobic bacteria *Nitrobacter*, converts the toxic Nitrite to non-toxic Nitrate through the process of oxidation. The Nitrate is non-toxic, when present in lower concentration. The plants, present in the pond, use this Nitrate, reduce the algal population and produce oxygen for the fishes and hence, helps to balance the pH in the pond.

(xiv) PHOSPHORUS

In water, the phosphorus is mostly present in the form of Phosphate (PO_4). It is a crucial nutrient for plants (Bhatnagar and Devi 2013). But the excessive phosphorus can lead to high production of algae and other aquatic plants, which can result in the downfall of dissolved oxygen, that is, Eutrophication. The high level of Phosphorus can also lead to algal blooms, that is, rapid growth of *Cyanobacteria* in the water, results in a colored scum, which are invasive in nature and can be harmful to the fish and other aquatic organisms.

(xv) PLANKTON

These are the pelagic, microscopic organisms, which are carried away in the water current. The Phytoplankton are the microscopic plants, that need light to perform the process of photosynthesis and prepare its own food, whereas, Zooplanktons are the small, microscopic animals, which are the main food of fish. There is a close relationship between the richness of Plankton and production of fish (Smith and Swingle 1939).

RESULT

The optimum range of various water quality parameters are summarized in the following Table 1.

Table 1: WATER QUALITY CRITERIA FOR POND WATER FISH CULTURE

Sr. No	Parameters	Acceptable Range	Desirable Range	Stress
1.	Temperature (^{0}C)	15-35	20-30	<12, <35
2.	Turbidity(cm)		30-80	<12, <80
3.	Water color	Pale to light green	Light green to light brown	Clear water, Dark green and Brown
4.	Dissolved Oxygen(mg/L)	3-5	5	<5, <8
5.	BOD (mg/L)	3-6	1-2	>10
6.	CO_2 (mg/L)	0-10	<5,5-8	>12
7.	pH	7-9.5	6.5-9	<4, <11
8.	Alkalinity (mg/L)	50-200	25-100	<20, >300
9.	Hardness(mg/L)	>20	75-150	<20, >300
10.	Calcium(mg/L)	4-160	25-100	<10, >250
11.	Ammonia (mg/L)	0-0.05	0-<0.025	>0.3
12.	Nitrite(mg/L)	0.02-2	<0.02	>0.2
13.	Nitrate (mg/L)	0-100	0.1-4.5	>100, <0.01
14.	Phosphorus (mg/L)	0,03-2	0.01-3	>3
15.	H_2S	0-0.02	0.002	Any detectable level
16.	Primary Productivity (C $L^{-1}D^{-1}$)	1-15	1.6-9.14	<1.6, >20.3
17.	Plankton (No. L^{-1})	2000-6000	3000-4500	<3000, >7000

These above-mentioned criteria if followed correctly, it will increase the fish production and also the farmers will be benefited by using economically sustainable pond for the farming of fish by maintaining the required parameters.

DETECTION OF POOR WATER QUALITY IN POND

For the detection of poor pond water quality, which are harmful or may even fatal for fish, the below mentioned instructions should be given to a fish farmer.

(i) If the pond water is clear, it indicates that the water is not productive and the growth of fish is not remarkable.

(ii) If the water is having a lot of soil particles, the flakes may be stucked in the gills of the fish and ultimately, result in their death.

(iii) If the application of Fertilizers, manure and other essential nutrients are more than enough, it may lead to the over-production of Planktons in the water, that imparts a deep green color to the water. The planktons are the main or primary source of food for the fish.

ISSN 2394 - 9554

(iv) If foul smell is coming out from the pond water, it indicates that the pond water is polluted. The main sources of pollution are the inflow of polluted water from some sources like rivers, ponds, the application of excessive amount of food stuffs into the pond water, or the application of chemicals to the crop fields present near to the pond.

(v) If the farmer noticed that the fishes are facing problem to get the dissolved oxygen and are present mostly at the water line, it indicates the low dissolved oxygen content of the water and hence, the fishes are facing such issue.

TREATMENT

There are different methods to treat the pond water from excessive involvement of the parameters. Some of the methods are:

(i)For lowering the temperature, shady trees can be planted near the pond or regular water exchange can be done.

(ii) By applying different inorganic or organic fertilizers to the crystal-clear pond water, the pond productivity can be increase.

(iii) If the management of phytoplankton is done correctly, the dissolved oxygen amount will not decrease and fish will get ample amount of oxygen for breathing and performing other metabolic activities. Over application of fertilizers can also be avoided to prevent loss of DO.

(iv) Addition of Gypsum ($CaSO_4$) or organic matters like cow dung, poultry droppings etc. can reduce the pH level.

(v) Alkalinity can be increased by the addition of calcium carbonate, carbonate blocks, limestone etc., which is completely dependent on the pH.

(vi) Addition of hydrated lime or quick lime can decrease the level of Ammonia.

(vii) By improving the feeding, increasing the aeration, regular water exchange, adding a small amount of chloride salt and use of biofertilizers can reduce the level of Nitrate.

DISCUSSION

Fish generally need some optimum conditions for their growth, development and survival. If their required conditions are changed by any means, it may lead to their stress and ultimately leads to their death. Sufficient amount of oxygen temperature, pH, turbidity, water hardness and many other factors are very crucial for the fishes for their growth, development reproduction and to sustain their lives in the water. So, keeping view on all these factors, the fish culturists can yield maximum number of fishes and eventually can be benefited.

CONCLUSION

Different water quality parameters in the pond are essential for the growth, reproduction and survival of the fishes. Only a single parameter can't affect the pond much, but a number of them collectively can affect the water of the pond and hence, also enhances the production of fish. So, by this knowledge about the water quality parameters, the farmers and fish culturists can be benefited by making required changes in the pond, to meet their need of fish production.

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