Water quality in pond

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Water quality is an important scientific tool to understand the dynamics of fish pond. It is necessary to have a clear understanding on the major water quality parameters affecting the fish production in any aquatic ecosystem system. A pond is the best example of an aquatic ecosystem. The main physical properties of water are depth, temperature, turbidity/ transparency etc. whereas the important chemical properties of water includes dissolved oxygen, carbon dioxide, pH, alkalinity etc.

Water depth

The pond will be neither shallow nor very deep. The suitable depth of water should be 1.5-2.0 meter for fish culture. Natural food production is very low in very deep pond. As a result the fish growth occurs slowly. The water of very shallow pond becomes very hot in summer which enforced the fish in stressed condition.

Water temperature

Fish is a cold blooded animal. Water temperature plays a very important role in regulating the activities of the cultured animal. The rate of chemical and biological reactions is said to be double at every 10°C increase of temperature. This means that aquatic organisms will use twice as much as dissolved oxygen and chemical reactions will progress twice as fast at 30°C than 20°C. It indicates that dissolved oxygen requirement of aquatic species is higher in warmer than in cooler water. The optimum temperature is about 25–30°C. Water temperature affects a multitude of important processes in aquaculture. Physiological processes in fish such as respiration rates; feeding, metabolism, growth, reproduction and rates of detoxification and bioaccumulation are affected by temperature. For removing rapid death of fish & for improving quality, morning or dawn is better time to release fish fry in the pond. If sunlight penetrates easily on the pond, then bottom temperature will good for fish.

Water transparency/turbidity

Turbidity is a measurement for light penetration in water. Turbid conditions result from dissolved and suspended solids such as clay particles or microorganisms such as phytoplankton. Clay turbidity in waters can cause gill damage, barrier for free movement and making fish stressed. Excess growth of plankton causes bloom in pond water and reduces DO content through two ways- less or no DO production by photosynthesis and more use of existing DO content for decomposition of the plankton cell. Sometimes fish can die due to high turbidity. Lime can be added to counteract the effects of clay turbidity. Turbidity can be measured by the help of a Secchi disk and appropriate management for aquaculture pond can be taken based on the Secchi disk readings/indications (Boyd, 1998). If the turbidity of water is found due to plankton and the Secchi

depth is found less than 20 cm (indicating too turbidity), there is no need of feed and fertilizer application. Immediate fertilizer application is required when the Secchi depth is found more than 60 cm (indicating transparent/clear water i.e., there is no plankton in the water). The desirable Secchi depth is 30-45 cm in fish pond.

Dissolved oxygen

Dissolved oxygen (DO) is a very basic requirement for aquaculture species. It is usually the first limiting factor to occur in pond aquaculture. Prolonged exposure to the stress of low concentration of oxygen lowers the physiological resistance to disease and inhibits fish growth. Dissolved oxygen in the pond water comes from two sources. Most of it comes as a by-product of photosynthesis and the other source is from the diffusion of atmospheric air. The amount of dissolved oxygen in the pond water is affected by many factors particularly water temperature, respiration and the level of organic matter. During daytime, more oxygen is produced through photosynthesis than is removed from the water by the respiration of animals. At night, both plants and animals continue to respire while oxygen is being added to the water only from the atmosphere. In some instances, the respiratory demand under certain circumstances cause total depletion of oxygen especially at daybreak causing anoxia of the cultured animals. The optimum level of DO for carp and shrimp is 5 to 8mg/l. Cat fish can tolerate low dissolved oxygen.

The causes of decreasing the amount of dissolve oxygen are (a) if the excess food deteriorates pond water; (b) during the excess decomposition of huge organic matter in water body; (c) if the phytoplankton grows excessively and makes bloom; and (d) if the temperature and salt concentration of water are increased. Effects of low dissolved oxygen are (a) fish come to surface & fight for survival; (b) fish shows faster and abnormal swimming; (c) after death the mouth of fishes are found opened; and (d) gas bubbles are found on the surface of pond water. Depletion of DO in the fish pond can be controlled by making agitation/movement in the pond water as an instant action applicable for sunny weather, not for cloudy weather) or by spraying water with pump. It is wise to consider pond construction in a manner so as to allow a greater contact of water surface with atmospheric air. Avoiding the plantation of large tree on dike is also a proven technique in this regards to get sufficient water mixing and to produce DO in pond water.

Carbon dioxide

Carbon dioxide (CO_2) is a natural component of surface waters. Diffusion from the atmosphere, fish respiration, and the biological oxidation of organic compounds are the major sources of carbon dioxide in surface waters. Extraordinarily high levels of carbon dioxide are of concern in aquaculture. This can occur in source water taken from ground waters. In addition, surface water

sources can have high levels of carbon dioxide when respiration is occurring at high rates. Thus, if source water is taken from surfaces waters at night or in the summer when respiration is high, there may be reason for concern. The suitable range of carbon dioxide in pond water range from 2 to 5mg/l. Due to high organic decomposition, carbon dioxide may increase up to 20 mg/l. When carbon dioxide concentrations are too high, the blood CO_2 levels of fish increase subsequently impairing the ability of hemoglobin to carry oxygen and causing respiratory distress. It occurs even at high oxygen levels and becomes more severe at lower oxygen levels. Either calcium hydroxide, also known as slaked or hydrated lime, or sodium carbonate may be added to reduce high levels of carbon dioxide. However, calcium hydroxide is cheaper and more widely available.

pH

The pH of water is its hydrogen ion concentration (H^+). It is expressed as the negative logarithm of the hydrogen ion concentration. The pH of the pond water is indicative to its fertility or potential productivity. Water with pH ranging from 6.5 to 8.5 is generally regarded as suitable for fish and shrimp production. Water with low pH can be treated with lime to neutralize the acidity. Water of excessive alkalinity (pH values > 9.5) may also be harmful to shrimp growth and survival. In ponds which are excessively rich in phytoplankton, the pH of pond water usually exceeds 9.5 during late afternoon. pH 4.0 is regarded as acidic death point whereas pH 11.0 is regarded as alkaline death point.

Effect of acidic water: if pH is lower than 5, then fish losses sodium & chloride from it's body; acidic water affects the fish gill and excretes mucous from body; and larvae and fry are affected easily by acidic water.Effect of base water: if pH is greater than 11, fish is died rapidly.Fish gill is fully spoiled by base water; lens & cornea of fish eye is totally spoiled; osmoregulation decreases; and breeding ability decreases.Low pH waters are often treated with lime. Alum can be used to treat high pH waters.

Alkalinity

Alkalinity is a measurement of the acid neutralizing capacity of water. If alkalinity is found lower than the expected range, water losesit's buffering capacityand primary productivity decreases. Total alkalinity is expressed in mg/l of equivalent calcium carbonate ($CaCO_3$). Alkalinity in natural freshwater systems ranges from 5 to 500 mg/l. Phytoplankton production is low in water with less than 20 mg/l alkalinity. Water is found poorly buffered with less than 30 mg/l. Desirable alkalinity should be within 40-200mg/l.