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Important Water Quality Parameters in Aquaculture: An Overview

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Water quality parameter is the physical, biological and chemical support in which they carry out their daily processes including as feeding, swimming, spawning, metabolism, development of fish body and excretion, which is an affordable source of protein and acceptability for the distribution and production of fish and other aquatic organisms explicitly or implicitly significant cash crop in many parts of the world (Bronmark and Hansson, 2005). After acquiring various types of pollutants which affect water quality, several professionals have reported the issues of water bodies (lentic and lotic) (physical, chemical and biological). Water quality characteristics in which all living organisms operate optimally have acceptable limitations. Within these parameters, a rapid decline or increase has negative consequences for essential physiological health of the aquatic organism (Davenport, 1993: Kiran, 2010). Fish are cultured in ponds (lentic water) in the majority of country and other countries, but regrettably, such farmers are unaware need of water quality standards in fisheries and aquaculture. They may acquire maximum fish production in the ponds by using minimum input cost and obtaining a high output of fish yield if they have been properly guided and kept informed of water quality management techniques. Temperature, transparency, turbidity, water colour, carbon dioxide, pH, alkalinity, hardness, ammonia, nitrite, nitrate, primary productivity, biochemical oxygen demand (BOD), plankton population, and primary productivity etc. all play a role for fish production. Can't be underestimated when it comes to maintaining a healthy aquatic environment and production suitable fish food organisms in ponds for improve fish production. As a result, it is necessary in order to ensure that these environmental factors are appropriately controlled and regulated in favor for fish survive and growth to their maximum potential.

Temperature

The degree of hotness or coldness in the body of aquatic organism, whether in water or on land, is known as temperature (Lucinda and Martin, 1999). Although fish are cold-blooded, their body temperature fluctuates in response to their environment, influencing the metabolism and physiology, and affecting the fish productivity. The rate of biochemical activity of the micro biota, as well as the rate of respiration rate increases when the temperature increases, due to the increase in oxygen demand. It also causes lower oxygen solubility and a rise in ammonia levels in water. However, gases like as hydrogen sulphide, carbon dioxide, and methane can build up to toxic levels under prolonged ice cover, impacting fish health.

Turbidity

Turbidity is the ability of water to transmit light in a ways that inhibits light penetration and limits photosynthesis and is the effect of multiple factors, including suspended clay particles,

plankton organism distribution, particulate organic matter, and pigments generated by organic matter decomposition.

Water colour

The water colour is visible to eyes and an object's colour is determined by the wavelengths of visible light that it reflects. Responsible for water colour changing such as plankton, high dense stocking fish, minerals, organic and inorganic fertilizers, algal blooms etc.

Dissolved Oxygen (DO)

Atmospheric air and photosynthetic planktons are the important resources of oxygen in water. Because of the low solubility of oxygen in water that also reduces with increased temperature, increased salinity, low atmospheric pressure, high humidity, high concentration of submerged plants, and plankton blooms obtaining sufficient oxygen is a significant challenge for aquatic organisms than for terrestrial species. Fish feeding and starvation, decreased growth, and increased fish mortality result from oxygen loss in water, either directly or indirectly (Bhatnagar and Garg, 2000). Fish, shrimp, and other aquatic species' growth, survival, distribution, behavior, and physiology are all affected by dissolved oxygen (Solis, 1988).

Low DO indicated than fish swim extraordinarily slowly and are affected if they reach to the surface of the water and also the secchi disc reading drops below 20 cm. When the fishes gulfing on the water surface itsindicated that deficiency of DO in the pond.

Biochemical oxygen demand (BOD)

The amount of total dissolved oxygen utilized by microorganisms during in the biodegradation of organic matters like as food particles or sewage is measured of the BOD. Excess cow and residential sewage from non-point sources, as well as an excess in phosphate in rural ponds, could be linked to a high organic load in these ponds, resulting in a higher BOD level.

Carbon-dioxide (CO2)

The major source of carbon pathway in nature is free carbon dioxide, a highly soluble gas in water that is produced by animal respiratory activities and it can exist in water as bicarbonate or carbonates in the dissolved or binding form in the earth crust, limestone, and coral reefs locations. When carbonic acid is dissolved in water, it produces carbonic acid, which reduces the Ph of any system, particularly those with poor buffering, and this pH decrease can be detrimental to aquatic species.

pH.

The negative logarithm of hydrogen ion concentration is being used to estimate pH. The quantity of carbon dioxide, an acidic gas, has a significant impact on the pH of natural waterways (Boyd, 1979). The usual blood pH of fish is 7.4, although a minor variation from this range, sometime range between 7.0 to 8.5, is more ideal and favorable to development of fish growth and reproduction activities. Fish can get stressed in water with a pH range from 4.0 to 6.5 and 9.0 to 11.0, fish death is almost likely at a pH less than 4.0 or even more than 11.0 (Ekubo & Abowei, 2011).

Alkalinity

The capacity of water to absorb changes in pH is known as alkalinity and measure of the overall concentration of bases in pond water, which includes carbonates, bicarbonates, hydroxides, phosphates, and borates, as well as dissolved calcium, magnesium, and other chemicals in the water. Alkalinity is primarily increased by lime leaching from cement ponds or calcareous rocks, photosynthesis, denitrification, and sulphate reduction, while alkalinity is decreased or consumed by respiration, nitrification, and sulphide oxidation (Stumn and Morgan, 1981: Cook et al., 1986), and to a lesser extent by evaporation and decomposing organic matter (Stumn and Morgan, 1981: Cook et If

the alkalinity is insufficient, however, it means that a tiny amount of acid can produce a significant shift in our pH.

Hardness

Hardness refers to the amount of alkaline earth elements like calcium and magnesium, as well as many other ions including aluminum, iron, manganese, strontium, zinc, and hydrogen ions, in a water body. Fish require calcium and magnesium for metabolic responses such as bone and scale development.

Calcium

Calcium is found as carbonate in soil and as a divalent salt in fish culture water, which is highly significant for the environment. Calcium may be absorbed by fish from both the water and the food they eat.

Conductivity

Conductivity is a measure of the overall ionic content of water, and hence shows thefreshness or otherwise of the water suggested by (Ogbeibu and Victor, 1995). Primary production (chemical richness) and hence fish production may be measured using conductivity. Water conductivity is depends on ionic concentrations ($Ca^{2+,}$ Mg^{2+}, HCO_3^-, CO_3-, NO_3-, and PO_4-), temperature, and dissolved solids fluctuations. Natural waters have a conductivity of 20-1500 mhos/cm, but distilled water has a conductivity of approximately 1 mhos/cm (Abowei, 2010). Freshwater conductivity values from 50 to 1500 hs/cm (Boyd, 1979), but it can approach 10,000 hs/cm in polluted environments, while in sea water conductivity is approximately 35,000 hs/cm and more.

Salinity

The total concentration of electrically charged ions (cations – Ca++, Mg++, K+, Na+; anions – CO_3-, HCO_3-, SO_4-, Cl-, and additional components such as NO_3-, NH_4+, and PO_4-) is defined as salinity. Salinity is the major supporting factor which is affects on the fish growth, density and growth of aquatic population.

Chloride

Chlorine (Cl^-) is a gas that would be added to water as a disinfectant to reduce dangerous germs, harmful bacteria and Chloride is also the same element available in the form of a salt; but, the both elements quite different chemical characteristics. Chloride is an important variable of most waterbodies, and it aids fish in maintaining osmotic balance.

Ammonia (NH3)

Ammonia is a byproduct from protein metabolism excreted by fish and bacterial degradation of organic waste such as discarded food, faeces, dead planktons, sewage, and so on. Ammonia in its unionized form (NH3) is highly harmful, but ammonia in its ionized form (NH4+) is not, and both forms are referred to as "total ammonia."

Effect

Gill damage, destruction of mucous-producing membranes, "sub-lethal" effects such as reduced growth, poor feed conversion, and reduced disease resistance at concentrations lower than lethal concentrations, osmoregulatory imbalance, and kidney failure are all common effects of ammonia in the range >0.1 mg L-11. Ammonia poisoning causes fish to become lethargic and frequently emerge near the surface gasping for oxygen.

Nitrite (NO2-)

Nitrite is a residue of the aerobic nitrification bacterial process, which is formed by the autotrophic Nitrosomonas bacteria when oxygen and ammonia are combined.

Effects

Nitrite is known as the "silent killer" of fish because it changes hemoglobin to methemoglobin in the blood, making the blood and gills brown and limiting breathing. It also causes harm to the fish's nervous system, liver, spleen, and kidneys.

Nitrate (NO3)

Nitrate is produced by the autotrophic Nitrobacter bacterium, which combines oxygen and nitrite to form ammonia and nitrite, which are poisonous to fish. Nitrate levels are usually consistent around 50 and 100 parts per million.

Phosphorus

Almost majority of the phosphorus (P) in water is in the form of phosphate (PO4), which is generally present in surface water as attached to living or dead particulate matter, and in the soil as insoluble Ca3(P04)2 and precipitated phosphates on colloids, save under extremely acidic circumstances. It is a crucial plant nutrient since it is frequently in short supply and encourages plant (algae) development, as well as its function in enhancing aquatic production.

Primary productivity

This would be the frequency at which photosynthesis occurs. The DO concentration of water is the most widely utilized productivity indicator. Net or gross primary productivity might be reported. The overall volume of additional organic matter generated by photosynthesis minus the amount of organic matter required for respiration is known as net primary productivity. Phytoplankton abundance can be measured using primary productivity in light and dark bottles.

Plankton

Planktons are aquatic pelagic animals that are propelled by the flow of the water rather than their own capacity to swim. Phytoplankton and zooplanktons are plant and animal components, respectively, that serve as fish food organisms (fig. 5). Plankton nets are used to collect them for identification (fig. 6). The amount of plankton and fish productivity is linked since plankton is at the base of the food chain (Smith, and Swingle, 1938).

Plankton blooms and fish kill

Eutrophication, or the excessive growth of planktons on the surface of a pond, may be caused by factors other than fertilization. Certain species of blue green algae grow to form dense scums in surface waters, starting to cause shallow thermal stratification, less soluble phosphate availability in the top layer, and preventing light penetration for photosynthesis to depths below 1m, resulting in anoxic conditions in the deep areas (lack of oxygen and high concentrations of free carbon dioxide), resulting in fish kills.

Significance

1. The primary goal of maximizing plankton production in an optimal quantity is to preserve the standing crop, and effective fertilization reduces the risk of an algal collapse.

2. Dense phytoplankton contributes to the production of 10 times greater oxygen than it consumes, allowing it to substitute for respiratory losses without increasing energy consumption.

3. Using primary production to produce fish is a low-cost option. Planktons also help to limit the growth of macrophytes that really are harmful to fish.

Disadvantage

The disadvantage is that it increases the water's whole Biochemical Oxygen Demand (BOD). Nutrients may subsequently recycle, creating in heavy scum.

How to detect pond water of poor quality

A fish farmer or fish scientist can use the following parameters to identify when pond water quality is decreasing and as such not acceptable for fish growth.

1. Clear water suggests low or no biological production; it is not nutritious enough for fish growth and reproduction.
2. In muddy water (water with a lot of clay particles), fish could have their gills completely blocked by the soil particles, resulting in death - not good for fish farming.
3. A pond's deep green water suggests an overpopulation of planktons, which serve as fish food but are caused by the addition of too much fertilizers, manure, or nutrient-rich feeds.
4. If a farmer observes fish having issues to get oxygen at the pond water surface in an already stocked, the water has a low DO content.
5. Control water resources from runoff urban and agricultural field, which is very toxic to fishes due to the higher organic or inorganic load.
6. Control pesticide/ herbicide or any chemicals near fish farming, releasing the water from this source after well treating by good processor.

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