Water Quality Management Program

Water Quality Management

Intensive and semi Wate quality for aquaculture refers to the quality of water that enables successful multiplication of desired organisms. Growth and survival which together determine the ultimate yield are influenced by a number of ecological parame ters and managerial practices. High stocking density of fish in ponds generate problems with water quality and sediment deterioration.

Water generated by aquaculture activity (faeces & unconsumed feed) first settle in the bottom as a consequences of organic waste and metabolites of degradated organic matter accumulated in sediment and water. Part of the waste is flushed out of the pond immediately or late after the organic matter has been degraded.

In a system of aquaculture salinity, PH and dissolved oxygen were the main parameters. In addition ammonical N (un-ionised plus ionised ammonia as nitrogen) increased exponetially with culture period and jumped to 6.5 mg/l after 75-80 days of cultivation.

Low dissolved oxygen level is the major limiting water quality parameters in aquaculture system. Dissolved oxygen level occurs in ponds particularly when algal bloom die off and subsequent decomposition of algal blooms and cause stress or mortality of prawns in ponds. Low dissolved oxygen level can reduce growth, feeding.

Major consequence of aquaculture production is a high concentration of dissolved nitrate, nitrites and ammonia. High feeding rates observed in prawns farms lead to eutrophic conditions characterised by phytoplankton blooms. These blooms ultimately senses and cause rapid increasing in ammonia in the ponds. The environmental conditions that create high ammonia concentration may also cause to culture organism or can induce to sublethal stress in culture population that results in lowered resistance to disease.

Ammonia accumulates in culture system following microbial decomposition of organic matter and with some fertilization practices. Microbial decomposition leads to low oxygen concentration. Low dissolved oxygen concentration increases the toxicity of ammonia to culture organism. Ammonia utilised as energy source by nitrifying bacteria and oxidised it to nitrite & nitrate.

Water Chemistry

A guiding principle of aquaculture is that water quality and hence efficient production are a direct consequence of good water chemistry. Water may be considered as 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 micro organisms, 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 organims. The levels of metabolites in the pond water that can have an adverse effect on growth of fish/prawans/shrimps for survival. Good water quality is characterized by adequate oxygen and limited levels of metabolites. The culture organisms, algae and micro organisms 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 micro organisms.

It is important to have firm grasp of some basic concept of water quality or water chemistry such as

- Temperature
- Salinity
- Dissolved Oxygen
- PH
- Ammonia
- Hardness
- Turbidity
- Redox Potential

Temperature

Aquaculture animals are cold blooded animals. They can modify their body temperature to the environment in normal condition. Fluctuation in temperature affect the growth rate of aquatic animals. It also affect metabolic activity and nutrient tolerance.

Salinity

Salinity plays an important role in the growth of culture organisms thru osmoregulations of body minerals from that of the surrounding water. for eg. the optimum range of salinity for shrimp is between 10 and 25 ppt, although the shrimp will accept salinity between 5 to 38 ppt. the early life stages of both shrimp and prawn requires standard seawater salinities but while growing they can withstand to brackishwater. However for better survival and growth optimum range of salinity should be maintained in the aquaculture pond.

Dissolved Oxygen

Oxygen is one environmental parameters that exert a tremendous effect on the growth and production thru its direct effect on feed consumption and metabolism and its indirect effect on the environmental conditions. Oxygen affect the solubility and availability of many nutrients. Low levels of dissolved oxygen can cause change in oxidation state of substances from the oxidized to the reduced form. Lack of dissolved oxygen can be directly harmful to the culture or cause a substantial increase in the level of toxic metabolites. Its therefore important to continuously maintain DO at optimum level of above 3.5 ppm.

Oxygen cycle and hence oxygen balance can be affected by what is known as the BOD of the pond. Decaying plant and animal matter consume substantial amount of oxygen in the decaying process. Its important to realize that the oxygen cycle and hence DO level can be affected by changes in the surrounding. Phytoplanktons and photosynthetic bacteria play important role in maintaining DO in the pond.

PH

PH is a measures of acidity or alkalinity. It is very important parameters to consider because it affect the metabolism and other physiological process of culture organism. Optimum PH for aquaculture system would be 7-8. PH can be changed by organic acid produced by anaerobic bacteria (acid formers) from protein, carbohydrate and fat from feed waste, mineral acid such as sulfuric acid.
One should notice drastic change of PH would cause stress to culture organism. Normally it should be maintained fluctuation within range of 0.4 difference. Control of PH is essential for minimizing ammonia and H2S toxicity.

Ammonia

Ammonia is the second gas of importance in fish culture, its significance to good fish production is overwhelming. High ammonia levels can arise from overfeeding, protien rich, excess feed decay to liberate toxic ammonia gas which conjuction with the fishes. Excreted ammonia may accumulate to dangerously high level under certain condition. Ammonia concentration are curbed or buffered by conversion to non toxic nitrate by nitrifying bacteria.

Hardness

Numerous inorganic substances are dissolved in water. Among these the calcium and magnesium with carbonate comprise the basis for the measurement of hardness. Optimum hardness for aquaculture is in the range of 40-400 ppm of hardness. Hard water have the capability of buffering the effect of heavy metals such as copper or zinc which are in general toxic to fish. The hardness is a vital factor in maintaining good pond equilibrium.

Turbidity

Water turbidity referes to the quantity of suspended materials, which interferes with light penetration in the water. In aqua culture ponds, turbidity can result from planktonic organism or from suspended clay particles. Turbidity limits light penetration , thereby limiting photosynthesis in the bottom layer.

Redox Potential

Redox potential is an index indicating the status of oxidation or reduction. Its correlated with chemical substance as O2, Co2 and mineral composed of aerobic layer. whereas H2S, Co2, Nh3 and other comprise of anaerobic layer. Micro organism are correlated with the status of oxidation or reduction. Its indicative of one of the parameters that shows the supporting ability of water and soil to the prawn biomass.
Photosynthetic bacteria plays an important role thru absorption and conversion of organic matter into the minerals and nutrient as secondary production, compared to the primary production of algal population.

Water Quality Management

Water quality parameters should be monitored to serve as guide for managing a pond so that conditions that can adversely affect the growth of prawns can be avoided. In cases where problems are encountered, these parameters can help in the diagnosis. so a remedy can be formulated. Individual parameters usually do not tell much, but several parameters put together can serve as indicators of dynamic processes occurring in the pond. Following will be the parameters that needs to be monitoring for proper water quality,

- Water Exchange
- Aeration
- Removal of dissolved metabolic organics
- Phytoplankton management
- Pond bottom treatment
- Nitrogen Metabolites
- Maintaining water quality and preventing disease

Aeration

Paddlewheels aerators are used to increase contact surface of water with air thereby increasing the area thru which oxygen is absorbed by the water and to create a circular movement of the pond water. This has the following advantages,

Increase the DO level of the water and prevent oxygen depletion during the night
It accelerate the diffusion effect of not only the oxygen but also enables the capture or release of Co2. Co2 is important for culture of algae and therefor maintenance of water color.
It facilitates the volatilization of undesirable gases such as N2, Nh3, Ch4 and H2S etc
It reduce the daily fluctuation range of PH value
It accelerates the decomposition and mineralization of organic matter in water and soil and helps in release of fertilier.
It helps in mixing the pond water and maintenance of ideal conditions all over the pond

Removal of Dissolved Metabolic Organics

Important stress factor is the increase of dissolved metabolic organic matter in water, it can increase ammonia and bacteria.

Dissolved metabolic organics Causes Stress

1) Decaying excess high protein feed ---------- Toxic ammonia/nitrate ----------Animal stop eating, weakness & susceptible to disease

2) Dead larvae, organisms, algae ----------Microorganism/bacteria ----------lower water quality

3) Animal excreta, urine ----------Increase biological Oxygen Demand

The best way to facilities the removal of metabolic waste in a pond is by flushing out water from the bottom. Constantly maintaining high DO in the pond thru supplement aeration and water exchange, enhance nitrification . Nitrification is a major mechanism for ammonia removal in well aerated ponds. Paddle wheel aerators are usually operated during dark when oxygen depletion is likely to occur and at noon when temperature and oxygen stratification can become significant.

Phytoplankton Management

Phytoplankton plays a significant role in stabilizing the whole pond ecosystem and in minimizing the fluctuation of water quality. A suitable phytoplankton population enriches the system with oxygen thru photosynthesis during day light hours and lowers the levels of Co2, Nh3, No2 and H2S. A healthy phytoplankton can reduce toxic substances since phytoplankton can consume Nh4 and tie up heavy metals. It can prevent the development of filamentous algae since phytoplankton can block light from reaching the bottom.

Pond Bottom Treatment

Many ponds in low lying area cant be completely drained and dried. To overcome this, farmers should apply waste digester to the pond. the digester are harmless bacteria (probiotics) and enzymes that consume organic matter in the pond bottom.

Nitrogen Metabolites

Large quantities of organic matter originating from the heavy feed load and feacal matter accumulated in aquaculture pond. These undergo oxidation reduction reactions leading to decomposition mainly thru the action of bacteria. different forms of inorganic nitrogen like ammonia,nitrite and nitrate are produced during decomposition.

Maintaining Water Quality & Preventing Diseases

Environmental conditions vary considerably at different times of the year and the bacterial & fungal load of seawater also varies. during the dry months, there is less dilution of organic and toxic pollutants from human and industrial waste. during this time the absence of rain also reduces water exchange between clean seawater and polluted coastal water. the result is a rise of viral, bacteria, protozoa, fungi and toxic pollutants in the water. This is partially upset during the hot summer months by phytoplankton and zooplanktons blooms which assimilate some of the bacteria and toxic substances. Under such conditions aquatic animals become vulnerable to the infection, They are stressed by the following,

Overcrowding in captivity

Temperature fluctuation of water, especially during water exchange
A temporary decline in DO due to power failure
Increase C02, un ionized ammonia and organics due to decaying excess feed and dead animals.
Physical man handling during water change.
Poor nutrition - improperly feed fish and prawns.
The high level of toxic pollutants that may contain heavy metals such as copper, zinc, lead, mercury and other chemicals like poly chlorinated biphenyl compounds, chlorinated hydrocarbons such as DDT and other pesticides.

Water Quality Parameters For Aquaculture

Water Parameters	Optimum Level
Temperature	26-33 degree celsius
Salinity	10-25 ppt
Dissolved Oxygen	More than 3.0 ppm
PH	7 - 8
Total Ammonia Nitrogen	less than 1.0 ppm
Total Nitrate Nitrogen	less than 5.0 ppm
Nitrite Nitrogen	less than 0.01 ppm
Sulphide	less than 0.03 ppm
BOD	less than 10 ppm
COD	less than 25-45 ppm

Address :
A Plot no 566, Karale Nagar, Degaon,
North Solapur, Maharashtra, India

Contact :
Ph.: 8888885375
E : support@microbialtech.com