

# ENVIRONMENTAL REQUIREMENTS OF SUGPO: PHYSICAL AND CHEMICAL FACTORS

by

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## INTRODUCTION

There are two important factors in the culture environment of either prawns or fishes that strongly determine the survival and growth of the stocks: (1) Biological, and (2) Physico-chemical factors. We are going to expound on the latter. Knowledge of the physical and chemical factors, such as temperature, turbidity, dissolved oxygen, carbon dioxide, pH, total alkalinity, and salinity, especially the effects of these factors to the productivity of the pond is vital in commercial fish farming.

## PHYSICAL AND CHEMICAL FACTORS

### A. Physical Factors

#### 1. Temperature

Temperature influences environmental factors such as dissolved oxygen and salinity of the water. At low temperature more oxygen is dissolved in water and at high temperature the salinity of the water increases due to evaporation.

Temperature acts directly upon the physiological processes of animals, particularly on rate of metabolism.

Animals take in oxygen and give off carbon dioxide. With rising temperature, the rate of oxygen consumption increases. Temperature also affects food consumption in fishes. Daily food consumption in carp is for instance, greater at 23-27°C, which is the preferred temperature than at 16-18°C and at 29-30°C.

Temperature has also an effect on the spawning of fish and crustaceans. Carp in natural waters, spawns at 17°C. In case of the gravid sugpo in the hatchery tanks, usually spawns at night time with a temperature ranging from 26 to 27°C.

Regarding their survival, Carp acclimatized at 20°C has been observed to have 50% mortality and 100% mortality at 37 to 39°C. For sugpo, they normally survive at temperature between 20 to 35°C. In a certain experiment, Sugpo (P<sub>10</sub>) died at temperature below 15°C and above 40°C.

## 2. Turbidity

Turbidity is due to rains, floods, or the action of finely divided organic matter in the water or on account of the nature of the pond soil itself. It may be permanent or temporary. It affects light penetration, hence disturbing the process of photosynthesis and is therefore unfavorable in relation to the supply of oxygen and food of the cultured animals.

### 3. Depth

The depth of water also affects light penetration in the bottom layers of the pond. Water in the pond must not be very deep nor very shallow. Too shallow pond gets warm rapidly and adversely affects the physiological state of the cultured stock. Very deep water, on the other hand, lessens the photosynthetic activity and therefore lowers the productivity of the pond. Turbidity, likewise, has a negative effect on the photosynthetic activity in the pond.

## B. Chemical Factors

### 1. Dissolved Oxygen

Dissolved oxygen, D.O., is of primary importance in its role in respiration and decomposition within the ponds. It comes from two sources: a) from the atmosphere, as a result of its interaction with the water, and b) from photosynthesis of phytoplankton and other submerged plants.

Stratification of water in ponds is common, especially during hot weather when there is little or no wind. When water does not circulate through the pond the deeper layers develop a shortage of oxygen. In fertile water containing blooms of phytoplankton, especially at night the zone of well-oxygenated water becomes relatively thin in the upper layer or to the water surface. At night the supply of oxygen may be reduced to such low that fish or prawn have too little oxygen for respiration.

Fish culturist can often save their fish by supplying aeration to the ponds. This aeration drives air into the pond and helps circulate the water. If aerations are not available, outboard motors or various manual methods may be used to stir the water and cause circulation in ponds.

Aeration in the hatchery tanks drives additional oxygen to the water and oxygen checks the activity of the anaerobic bacteria, thus preventing the production of  $H_2S$  which is a poisonous gas.

Based on our experiments, the lethal concentration of D.O. for Sugpo are as follows:

|                  |          |              |
|------------------|----------|--------------|
| Zoea stage ----- | 0.54 ppm | for 25 hours |
| Postlarvae ----- | 0.81 ppm | for 5 hours  |
| Juvenile -----   | 0.64 ppm | for 2 hours  |
| Adult -----      | 0.76 ppm | for 5 hours  |

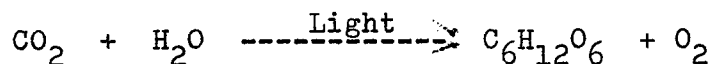
The experiments started with a uniform D.O. of 5.00 ppm.

## 2. Free-Carbon Dioxide

Carbon dioxide,  $CO_2$ , is present in air at 3 parts per 10,000. Pure water at 1 atmosphere air pressure at  $25^{\circ}C$  contains only 0.40 ppm  $CO_2$  when in equilibrium with  $CO_2$  in air. In deep waters, much higher  $CO_2$  concentrations are built up due to their release by respiration and decomposition.

Concentration of CO<sub>2</sub> in excess of 15 ppm is detrimental to pond fishes. Those fish able to gulp air at the surface can survive 100 ppm, whereas of those unable to gulp air find difficulty in breathing at 30 ppm and may die at slightly higher concentrations.

CO<sub>2</sub> plays in the photosynthetic reaction. Planktons need this chemical compound for their manufacture of food:



Since water acidity can be attributed to the presence of CO<sub>2</sub>, this compound influences the pH and alkalinity of the water. It tends to lower the pH and increases the bicarbonate alkalinity of the water.

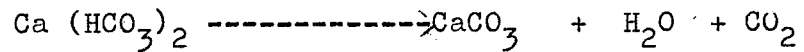
### 3. Total Alkalinity

Total alkalinity has been taken as a good measure of productivity of waters by several authors. Higher alkalinity values gives higher productivity of ponds.

| <u>PPM CaCO<sub>3</sub></u> | <u>Significance</u>  |
|-----------------------------|--|
| 10 - 50                     | 1. water not productive<br>2. CO <sub>2</sub> supply is poor<br>3. dangerous to fish |
| 50 - 200                    | 1. productivity medium<br>2. CO <sub>2</sub> supply medium                           |
| 500                         | 1. productivity alleges to decline<br>2. rarely found                                |

Alkalinity is largely calcium and magnesium salts and more or less equivalent to hardness. However, it is not the hardness nor alkalinity alone that is responsible for high natural fertility, but the fact that high calcium content of soils is usually correlated with a high content of phosphates, nitrogen and other plant nutrients.

The cyclic carbon principally useful in photosynthesis is that present as free-CO<sub>2</sub> and half of it is present as bicarbonate, HCO<sub>3</sub>. Where plankton is abundant in the zones of active photosynthesis often all free CO<sub>2</sub> has been used up plus most of all of that released from the bicarbonates as the CO<sub>2</sub> tension decreases;

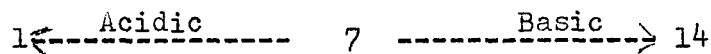


so that the pH rises to 9.5 or 10.0

Total alkalinity is inversely proportional to pH.  
If the total alkalinity is high the pH is low.

#### 4. Hydrogen Ion Concentration, pH

The measure of the acidity or alkalinity of a solution is expressed in pH. Pure water has pH value of 7, which is neutral.



A solution with pH 5 is 10 times acidic as one with pH 6. One with pH 4 is 100 times as acidic as one with pH 6. pH values ranging from 7-9 is a characteristic of good water suitable to fish life. While pH less than 6.0 and more than 10.0 is found unsuitable.

### 5. Salinity

The content of dissolved salts in sea water is usually expressed as salinity. Prawns can live within a wide range of salinity. They can survive at salinity range from 10-40 o/oo

Abrupt changes in salinity is harmful to prawn.

### CORRELATION OF CHEMICAL FACTORS

From our experimental ponds, data are correlated as:

|      | H <sub>2</sub> O temp. | D.O. | pH   | To. Alk. | Salinity | CO <sub>2</sub> |
|------|------------------------|------|------|----------|----------|-----------------|
| 6 AM | low                    | low  | low  | high     | low      | high            |
| 3 PM | high                   | high | high | low      | high     | low             |

In the hatchery tanks, since the water is not directly exposed to the sun, and also supplied with aeration, the fluctuation of chemical factors is not much as compared to that in the experimental ponds.

Ranges of Chemical Factors

PONDS:

|      | (°C)                  | (ppm) |       | ppmCaCO <sub>3</sub> | o/oo     | ppm             |
|------|-----------------------|-------|-------|----------------------|----------|-----------------|
|      | H <sub>2</sub> O temp | D.O.  | pH    | Alk.                 | Salinity | CO <sub>2</sub> |
| 6 AM | 24-28                 | 2-6   | 7-8   | 100-190              | 23-30    | 0-10            |
| 3 PM | 30-36                 | 6-12  | 8-8.5 | 90-170               | 30-35    | negligible      |

HATCHERY TANKS:

|      |       |     |       |         |       |            |
|------|-------|-----|-------|---------|-------|------------|
| 9 AM | 26-29 | 4-8 | 7-8.5 | 100-150 | 28-33 | negligible |
|------|-------|-----|-------|---------|-------|------------|