# Assessment of Physico-Chemical Parameters of Selected Fish Farms Near Kolleru Lake, Andhra Pradesh, India

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**Abstract**

**Assessment of diurnal fluctuations and seasonal variations in physico-chemical parameters of freshwater ponds conducted on monthly basis. In the present study fluctuations and variability in water Temperature, pH, Dissolved oxygen, Alkalinity, Total hardness, Ammonia, Carbon dioxide and transparency have been observed. The water temperature, DO levels, pH, Alkalinity, Total hardness and Ammonia, Carbon dioxide and transparency were found to vary between 24 0C and 37 0C, 3.0 ppm and 17.5 ppm, 6.0 and 8.0, 200 ppm and 780 ppm, 210 ppm and 800 ppm and 0.01 ppm and 0.04 ppm,6.7ppm and 338 ppm and 21.5cm and 5 cm respectively in the farm at different months of the study period. Maximum values of temperature, dissolved oxygen, pH, Alkalinity, total hardness, ammonia, carbon dioxide and transparency were recorded as 32.9 0C at 16:00 (June). 17.5ppm at 16:00 (March), 8.0 at 14:00-16:00 (April), 570 ppm (May), 800 ppm (May), 0.04 ppm, at early hours in morning (January) and 338 ppm (March) and 21.5 cm (Feb), respectively. Also, the lowest values of above were, 240C between 2:00-6:00 (Jan, Feb & March) 3.0-4.0 ppm between 2:00-6:00, 6.2 (Feb & March), 200ppm (Dec), 177 ppm (Dec), 0.01 ppm during early and late morning hours, 6.7 ppm (Dec) and 5.0 cm (May) respectively. The pH value of the water was found slightly alkaline during the study period but there was no significant variation observed diurnally. DO and temperature were fluctuated significantly in diurnally and seasonally. Temperature, DO, pH, Alkalinity and hardness were recorded as maximum during summer than monsoon and winter. Based on the findings, the data useful for conversation and monitoring of the pond and the fish ponds are moderately soft category recommended for aquaculture.**

**Keywords: Water quality, Season, Fish ponds**

## Introduction

Biological communities of water living are integrated with water chemistry hence water quality and its management basically important in aquaculture. Quality of water that enables successful optimum growth and survival of culture fish species. Pond water exhibits continues and constant fluctuations due to presence of living organisms. Exchange of atmospheric gases such as oxygen, carbon dioxide, nitrogen in the pond water play vital role in the process of fish metabolism and plant photosynthesis in the pond environments. Pond culture aquaculture systems are commonly followed by the fish farmers., Water quality parameters are very is important in such culture systems to study the physical and chemical properties than open systems.

Water quality characteristics of aquatic environment arise from a multitude of physical, chemical and biological interactions (Ugwu&Wakawa, 2012) while some of these interactions are toxic to the ecosystem, some are providing nutrients to aquatic organisms and others are responsible for the aesthetics of the water body (Boukari et al., 1999). Maintenance of water quality is the primary practice for successful pond culture operations apart from fish food organisms (plankton), feed supplements and soil etc. The physical and chemical characteristics of pond water are major determinants of biogenic productivity. Growth, development & maturity of fish are affected with changes in physico- chemical parameters of water (Jhingran, 1985).

Comprehensive data are available on water quality of fish ponds in India. The data of a systemic and extensive study of physico-chemical conditions of a number of ponds and tanks in various districts of Madras and Andhra Pradesh (Menonet al.1959). Water quality of various fish ponds in Uttar Pradesh and given the range and average for individual water quality for ponds with high, average and poor

productivity(Upadhyaya.1964). In a depth-wise diurnal and seasonal changes of physico- chemical factors in Sathiar reservoir, the results indicate that physico- chemical factors are inter-related (Kannan V. and Job S.V). pH, Carbon Dioxide, Alkalinity and Hardness in Fish Ponds are interacted each other that since alkalinity increases pH, ammonia will be more toxic in waters with high total alkalinity. Hardness is not typically associated with ammonia toxicity (William A. Wurts and Robert M. Durborow, 1992)

Assessment of physico-chemical water quality and algal biodiversity studies were made in many freshwater reservoirs, freshwater lakes including polluted lakes freshwater ponds, tropical ponds, Shallow ponds, temperate ponds, Village ponds and ground water tank, pest contaminated aquaculture ponds and the rivers in India.

The pH, DO, alkalinity, dissolved nutrients are important for phytoplankton production (Bais&Agarwal, 1990). Water quality and zooplankton movement undergo rapid changes due to diurnal variations in pond (Rana et al., 1982, and Ahmad and Singh.1991). According to Wetzel (1983) the productivity of freshwater community that determines the fish growth is regulated by the dynamics of its physic-chemical and biotic environment. Transparency, Total solids, Total dissolved solids, and Turbidity was maximum during rainy months. The pH, Conductivity, Hardness, Dissolved Oxygen (DO), Biological Oxygen Demand (BOD) were higher during summer months and the Chloride concentration was high in the month of January- reported in Andhra Pradesh (Ramulu and Benarjee, 2013). Remarkable seasonal variations observed during study period in mean density of Chlorophyta and Euglinophyta with influence of water quality parameters and the interrelationship between the hydro chemical properties and phytoplankton assemblage (Nirma Kumar et al. 2011). pH is important chemical parameter as it affects the metabolism & other physiological process of culture organisms and also determines the solubility and chemical nature of most substances. According to Welch (1952) the pH of water bodies could serve as an index of other environmental parameters (CO2, DO & dissolved nutrients). A certain range of pH (6.5-9.0) should maintain for acceptable growth and production. Nees (1946) &Banerjea (1967) observed the variations in water pH from 7.1-8.0 as optimum for fish production.

pH changes in pond water mainly influenced by CO2 and ions in equilibrium with it (Boyd, 1979).

The pH of water is neutral to slightly alkaline and found within the permissible limit of 6.5 to 8.5. Increase in pH may be associated with increase in DO produced as a result of photosynthesis as has been emphasized by Sreeenivasan (1967), Unni (1972), Otsuki& Wetzel (1974), Sehgal (1980) and Khajuria (1992). Decrease in pH is in accordance with the decline in CO3 concentration and rise in HCO3 content.

George (1961) reported diurnal changes of only 0.4 to 0.6 pH units in shallow ponds in Delhi under conditions of Microcystis bloom. There is a positive co-relationship between pH and temperature as diurnal variation in fresh water fish pond (Praveen Ojha and A. K. Mandloi, 2004 and Tapashi Gupta et al.2011).

Temperature directly affects the various activities and metabolic process of organism ( Hutchinson, 1957). The rate of decomposition of organic matter in water is highly influenced by temperature regime of a water body (Karause, 1962) and considered as an important factor in controlling the fluctuation of plantation and functioning of aquatic ecosystem (Wetzel, 1975; Dwivedi and Pandey, 2002; Singh and Mathur, 2005). High temperature causes increase in rate of biochemical activity of micro biota, plant respiration and raises oxygen demand and its solubility, level of ammonia in water. 30-35 oC is tolerable to fish (Delince, 1992). 28-32 o C temperature is for the tropical major carps (Bhatnagar et al. 2004). thermal stratification usually occurs during calm and warm afternoon in the pond environment

Oxygen affects the growth, survival, physiology of organism (Solis, 1988). Dissolved oxygen low levels indicated by fish sluggishly swim and are weakened. Adequate oxygen and limited levels of metabolites are important in which determines water quality. According to Banerjea (1967) dissolved oxygen between 3.0 5.0 ppm in ponds is unproductive. Bhowmick, 1968, Jana (1978) and Chakraborty (1980) recorded a fluctuating of dissolved oxygen in experimental ponds. Oxygen affects solubility and availability of many nutrients; lack of dissolved oxygen can be directly harmful to culture organisms or cause a substantial increase in the level of toxic metabolites. A definite diurnal change of oxygen concentration noticed as the oxygen content was at a minimum in the early morning and at a maximum in the afternoon (Butcher, Pentelow& Woodley.1927)

Alkalinity, a measure of the total concentrations of bases in water and it influences -H changes. Water with total alkalinities of 20-150 mg/l-1 have suitable quantities to permit plankton growth (Boyd

&Lichtkoppler.1979). According to Santhosh& Singh (2007) the ideal values for fish culture 50-300 mg/l and >300 ppm is undesirable due to non availability of Co2. Alkalinity 80-200 ppm is desirable for fish/spawn production. Total alkalinity < 100 mg/1-1 not suitable for fish culture (Screader, 1980 and Banjerjea, 1967). Numerous inorganic (mineral) substances are dissolved in water.

Hardness of water is principally due to salts of Ca++and Mg++mainly the carbonates and sulphates (Wadia, 1961). The desirable range is 50-150 mg/1-1 as CaCO3 (Stone &Thoforde, 2004). Moderately

alkaline pH favours the fish food organisms and also the fish production (Das, 1961; Jhingran, 1991). According to Bhatnagar et al.(2004) hardness value less than 20 ppm can cause stress, 75-150 ppm is optimum for fish culture. >300 ppm lethal to fish as it increases pH, nutrient availability minimized. Lakshmanam et al. (1967) recorded poor production of plankton and fish in acidic ponds in Assam having poor calcium content.

Water transparency is an important factor that controls the energy relationship at different trophic levels. The maximum transparency was recorded in winter season attributed to the sedimentation of suspended matter (Chaurasia and Adoni, 1985; Sinhaetal., 2002; Kadametal., 2007; Shah and Pandit, 2012). McCombie (1953) has also observed transparency of water dependent upon silt, microscopic organisms and suspended organic matter. The higher accumulations of sediments during rainy monsoon may increase turbidity and decrease transparency. During the end of September or early October, the rainy season is practically over, the suspended matter settles down and water becomes more transparent as the turbidity decreases. Water rich in FCO2 is comparatively less alkaline and vice versa as stated by Rao (1955), Atkins (1962) and Saha (1981).

An increase in alkalinity observed during summer in Vellayani Lake, Kerala (Radhika et al .2004). Narayan et al. (2007), Bajaj (2010) who argued that total alkalinity is usually higher during pre- monsoon than monsoon. The total alkalinity was maximum during monsoon and the minimum during summer (Iqbal&Katariya. 1995).

CO2 concentrations in ponds are mainly governed by the aquatic metabolism, i.e. by the balance between respiration and photosynthesis. The most important contribution of CO2 is that it serves as an important source of organic carbon (Reid, 1961) for biota. Minimum and maximum values of free carbon dioxide were observed during summer and winter, respectively (Baruahet al.1998). John Hargreaves and Martin Brunson (1996) developed a graphical technique for estimating carbon dioxide concentration in ponds using alkalinity and pH values of water. According to Jhingran (1988) the decomposition of organic sediments in water bodies is always associated with accumulation of CO2, decrease in pH and increase in bicarbonates.

The values of DIC were strongly influenced by the fraction of CO2 and it was observed a predominance of the fraction HCO3- in the afternoon. The flow of CO2 in the interface atmosphere/water showed variations during the day (Huan Jing KeXue (2012) indicated by diurnal variations of CO2, CH4 and N2O fluxes at the water-air interface were determined in a shrimp pond, and a mixed culture pond of fish and shrimp, showed that water temperature and Chlorophyll were the major factors affecting the CO2 fluxes, and dissolved oxygen, PO4(3-) and pH were the major factors affecting the CH4 fluxes at the water-air interface of the mixed culture pond of fish and shrimp.

Based on the review observations/ studies there are limited works has been done on diurnal and seasonal variability studies in freshwater fish culture ponds. The objective of the present study to investigate the interactions between the water quality parameters and season of diurnal variation in selected fish culture ponds near Kollerulake in Andhra Pradesh.

## Material and Methods

The ponds were selected under investigation with the average depth of pond is 4.0 M. minimum water depths recorded during summer and had increasing level from July to September and gradually decrease starting from May-Jun, 2018. The samples were collected randomly from different points in pond with a depth of 30-40 cm and were mixed together to prepare an integrated sample. The collected samples were brought to the laboratory and analyzed immediately. All the parameters were analysed using APHA Standard Procedures (1980). Water temperature was measured by Mercury thermometer. pH measured by pH meter. Alkalinity and hardness measured by standard titremetric methods. And total Ammonia determined by test kit (Nice test kit) and Transparency was determined by Sechi Disc method from 6:00 am to 5:00am hours for 24 hrs (except for Transparency). Carbon dioxide was calculated using the source table

of Tucker (1984) which includes water pH, Temperature, Alkalinity and multiplication factor. Carbon dioxide determined as a multiplication of alkalinity by factor given in reference table. The four months make one season, summer (March-June), monsoon (July-October) and winter (November-February). Results and discussion: Water quality parameters such as pH, water temperature, Dissolved oxygen, total alkalinity, Total hardness, and Secchi disc transparency were estimated in the study. The results were presented.

$Co_2$ concentrations were calculated by using multiplication factor table, source: Tucker (1984).

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The pH value (6.2-8.0) of pond showed alkaline trend with a few variations during the study period. The consumption of carbon dioxide during photosynthesis causes pH to peak in the afternoon and accumulated of CO2 during dark causes pH to be at its minimum. During summer the highest PH recorded as 8. 0 at 13:00-16:00 (April) the pH during winter recorded as highest

7.8 at16:00-18:00 (December) and during rainy season PH value observed as 7.5 as highest. It is evident from the data that no high degree of variability in the concentrations of PH and also for ammonia. The maintain of daily fluctuations of PH within the range of 6.2-8.0 in the present study period. Control of PH is essential for minimizing ammonia and H2S toxicity. Rama Krishana N. (2003) reported that pH increased in summer due to increases bicarbonates in water, similar findings recorded in water of present study ponds.

The temperature differentiates 5.5 oC. In the present investigation seasonal variability of atmospheric and water temperature have been observed. The highest temperature was recorded during summer as 37 oC (at 15:00), during winter as 32 oC (at 14:000 and during rainy season as 35 oC (at 12:00) It was maximum during summer comparatively less during monsoon and winter. The minimum temperature recorded as 24 oC (Jan, Feb & Mar) during study period. Temperature gradually declines from evening to dawn. Observations on monthly fluctuation in water temperature recorded that the maximum water temperature recorded as 37.0C. During rainy months decline in the water temperature.

Oxygen concentration in pond water exhibits a diurnal pattern with the maximum occurring during afternoon10-17.5 ppm may be due to photosynthetic activity and minimum occurring at night to dawn time respiration 3.0-4.0 ppm. During summer as the temperature is high, DO also obtained highest concentration this indicates there may be a strong positive correlation between DO and temperature. DO during winter observed as 14.0 ppm, where as in monsoon 13.5 ppm as maximum levels. During early hours in morning when the oxygen content fell below 4.0 ppm.

Temperature and Dissolved oxygen were significantly fluctuated during day time and varied seasonally. Alkalinity range of 570-200 ppm was recorded during study period. The highest levels of alkalinity 570 ppm during summer, 330 ppm during rainy and 430 ppm in winter season were recorded. Total alkalinity was recorded as minimum in monsoon and high during summer season, similar results obtained by Garge et al., (2006) and Verma et al., (2011 & 2012). The highest hardness recorded as 800 ppm during summer (May), 520 ppm during rainy (July) and 400 ppm in winter (November). Seasonally, highest value was recorded during summer and lowest during the winter season. Hulyal and Kaliwal (2011) found that higher value in summer and lower in winter season. Similar observations were found by various workers (Kumar, 1995; NaiakPurohit, (1996); Kaur et al., (2000); Nair, 2002 and Sinha and Biswas (2011) and Khan er al. (2012). Hardness is a vital factor in maintaining good pond environment. TH ranged from 177 ppm to 800 ppm recorded during the study period. Higher value of hardness is due to decreases in water volume and increases in rate of evaporation at high temperature during summer. Kiran (2010) reported that water can be Categorized according to degree of hardness as soft (0-75mgl-1) moderately (75-150 mgl-1) hard (150-300mgl1) and above 300mgl- 1 as very hard. On the basis of the observation, the water of the present pond appears to be hard seasonally. Mostly alkalinity and hardness values are similar during experiment period which shows there may be a positive co-relation. Results of Carbon dioxide concentration indicated that as the water temperature decline the concentration of dissolved carbon dioxide was increased as well as increase in PH causes decline in carbon dioxide concentration in water.

The results of transparency ranged between 5.0 cm. to 21.5cm. During the study period it was low during the summer as 5.0 cm (May) and higher as 21.5 cm (Feb) during the winter season. The transparency was lower in the summer season due to decreased water levels in pond. Maximum and minimum value showed in (Table No.I). The biological productivity, suspended non-living particles and watercolor, wind velocity rainfall and nature of bottom such factors mainly affect the transparency. Diwedi et al. (2000) was recorded

the maximum value of transparency in winter. The findings of the present study is expected to help get awareness on water quality characteristics and implementing scientific management practice if necessary and also present findings carried to fish farmers and suggest them to do good fishery culture practices.

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