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Study of Physico-Chemical Parameters and Planktons of Water Samples From Taraori Pond And Karna Lake, Karnal (Haryana)

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ABSTRACT: *An investigation was made of the physical, chemical conditions and planktons of the pond water. Temperature, pH, CO2, dissolved oxygen, chloride, phosphate, alkalinity, nitrates, organic matter, nitrogen, salinity, etc. were measured monthly. Stastical analysis of these factors showed some significant correlations.*
Keywords: *pH, salinity, hardness, alkalinity, chloride*

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I. INTRODUCTION

The water is one of the most important components of the ecosystem. Living things exist on the earth because this is the only planet that has the existence of water. It is necessary for the survival of all living things, be it plant or animal life. It is the most abundant commodity in nature but also the most misused one. Although earth is a blue planet and 80% of earth's surface (80% of the total 50,000 million hectares in area) is covered by water, the hard fact of life is that about 97% of its locked in oceans, sea which is too saline to drink and for direct use for agricultural or industrial purposes. 2.4% is trapped in polar icecaps and glaciers, from which icebergs break off and slowly melt. Less than 1% water is present in ponds, lakes, rivers, dams etc. which is used by man for industrial, domestic and agricultural purposes. India receives about 1400-1800 mm of rainfall annually. About 96% of this water is used for agriculture, 3% for domestic use and 1% for industrial activity. An analysis revealed that about 70% of all the available water in our country is polluted due to the discharge of effluents from the industries, domestic waste, land and agricultural drainage (Shrivastava and Kanungo, 2013).

The aquaculture sector of the world has enhanced its technology and capacity building as well as the translation from experimental ideas of laboratories to its practical use by the common masses. Culture fisheries are practiced in small water bodies throughout the world and are particularly common in Asia where the practices are found in communal lakes, reservoirs and village ponds as well as private farm ponds. The primary function of constructing village ponds or reservoirs is for the storage of water for domestic utilization and crop irrigation; however they are also used for fishing or fish culture. The productivity level of a water body is a characteristic feature by which the living substance is manufactured through interactions of the constituents of the natural environment. Ponds are essentially self-sustaining systems where the abiotic component like light energy, inorganic nutrients and biotic components like producers and consumers act together. This helps in production of aquatic biota, which serves directly or indirectly as food for fishes. Different studies have carried out work on pond ecosystems. It has been noted that although pond culturing has been intensifying, there have not been sufficient accounts of physicochemical and biological characteristics. Various temporary water bodies and artificial ponds of different sizes exists in Haryana, India which are used extensively for managed culture fisheries system and make an interesting biotype for physicochemical studies.

The optimum fish production is totally dependent on the physical, chemical and biological qualities of water to most of the extent. Hence, successful pond management requires an understanding of water quality. Water quality is determined by variables like temperature, transparency, turbidity, water color, carbon dioxide, pH, alkalinity, hardness, unionised ammonia, nitrite, nitrate, primary productivity, biological oxygen demand (BOD), plankton population etc. Water quality is determined by various physico-chemical and biological factors, as they may directly or indirectly affect its quality and consequently its suitability for the distribution and production of fish and other aquatic animals (Moses, 1983).

Fish is an inexpensive source of protein and an important cash crop in many regions of the world and water is the physical support in which they carry out their life functions such as feeding, swimming, breeding, digestion and excretion (Bronmark and Hansson, 2005). Many workers have reported the status of water bodies (lentic and lotic) after receiving various kinds of pollutants altering water quality characteristics (physical, chemical and biological). All living organisms have tolerable limits of water quality parameters in which they perform optimally their activity. A sharp drop or an increase within these limits has adverse effects on their body functions (Davenport, 1993; Kiran, 2010). So, good water quality is very essential for survival and growth of fish. As we know fish is an important protein rich food resource and there has been sharp increase in demand of fish products due to increasing population pressure in this century. Thus to meet the demand of present food supply, water quality management in fish ponds is a necessary step that is required to be taken up.

In most of the countries, fishes are cultivated in ponds but unfortunately such culturists are not so aware of importance of water quality management in fisheries. If they are properly guided and made aware about water quality management practices, they can get maximum fish yield in their ponds to a greater extent through applying low input cost and getting high output of fish yield. The role of various factors like temperature, transparency, turbidity, water color, carbon dioxide, pH, alkalinity, hardness, ammonia, nitrite, nitrate, primary productivity, biochemical oxygen demand (BOD), plankton population etc. can't be overlooked for maintaining a healthy aquatic environment and for the production of sufficient fish food organisms in ponds for increasing fish production. Therefore, there is the need to ensure that, these environmental factors are properly managed and regulated for good survival and optimum growth of fish. Fish do not like any kind of changes in their environment. Any change adds stress to the fish and the larger and faster the changes, the greater is the stress. So the maintenance of all the factors becomes very essential for getting maximum yield in a fish pond. Good water quality is characterized by adequate oxygen, proper temperature, transparency, limited levels of metabolites and other environmental factors affecting fish culture. The details of various pond ecosystems also have been studied by workers (Mumtazuddin *et al*., 1982; Garg and Bhatnagar, 1999; Bhatnagar, 2008). Bhatnagar and Singh (2010) studied the pond fish culture in relation to water quality in Haryana. The environmental conditions in water bodies are constantly changed by various natural and human induced factors. The features of the physico-geographical environment of the catchment area, as well as the morphometric parameters of the water body and its hydrological regime, accelerate or block the supply of organic matter to the lakes, which affects its trophic level, water, pH and hardness, conductivity and colouring, light and oxygen availability, and consequently algae and plant species diversity (Chobot and Banas, 2008**)**.

As raw domestic sewage passes through a series of stabilization ponds, there is a settlement of wastes into sludge which is effectively decomposed by bacteria. These, in turn, are fed on by ciliated protozoans (Madoni, 1991) which can reduce the load of pathogenic fecal bacteria to 5% (Curdsand Fey 1969). The improved water quality allows dense phytoplankton blooms to develop, an increase in the oxygen levels and the consequent development of rotifers, cladocerans and crustaceans. These being important constituents in the diet of fish, sewage treatment ponds could be profitably used for aquaculture too (Sreenivasan, 1980). It is well known that productivity of fish ponds depends largely on the abundance of fish food organisms and also on occurrence of congenial environmental condition in the pond.

At present, world's water resources are under pressure and are in danger because of potential pollution and contamination due to rapid industrialization, increasing population pressure, urbanization, modern agricultural activities and other anthropogenic activities (Hatcher and McGillivary**,** 1979; Hutley, 1990; Agarwal *et al.,* 2006 and Singh *et al.,* 2007). But these alone cannot be blamed for ruining the aquatic systems,'Mass bathing' which is an age old ritual in India, has also a big hand in it. It is sheer irony that thoughscriptures prohibit mass bathing and throwing usedfloral offerings into the water body, but all of thisis done with unparallel zeal. Mass bathing increases the organic matter in the water body,apart from impurities like soaps, detergents and a lot of clothes. Several studies have been done on the impact of mass bathing on different water bodies (Sinha *et al.,* 1991; Lal, 1996; Dhote *et al.,* 2001; Chandra and Prasad, 2005; Kulshreshtha and Sharma, 2006, BBWQ, 2007). Physical factors such as climate (temperature, wind, precipitation, and solar radiation) are also important determinants of water quality in lakes and all critically affect the lake's hydrologic and chemical characteristics, and indirectly affect the composition of the biological community (Najafpour *et al.,* 2008).

Dissolved oxygen affects the growth, survival, distribution, behaviour and physiology of shrimps and other aquatic organisms (Solis, 1988). The principal source of oxygen in water is atmospheric air and photosynthetic planktons. Obtaining sufficient oxygen is a greater problem for aquatic organisms than terrestrial ones, due to low solubility of oxygen in water and solubility decreases with factors like- increase in temperature; increase in salinity; low atmospheric pressure, high humidity, high concentration of submerged plants, plankton blooms. Oxygen depletion in water leads to poor feeding of fish, starvation, reduced growth and more fish mortality, either directly or indirectly (Bhatnagar and Garg, 2000).

Fertilization may not be the only reason for eutrophication or excessive growth of planktons in pond water surface. The growth of certain species of blue green algae form dense scums in surface waters, cause shallow thermal stratification, less availability of soluble phosphate in the top layer and prevents the penetration of light for photosynthesis to depths below 1m so leading to anoxic conditions in the deep areas (lack of oxygen and high concentration of free carbon dioxide) resulting in fish kills.

Bhatnagar and Singh (2010) suggested the optimum plankton population (approximately 3000-4500 Nos. L^{-1}) in pond fish culture.

Present study was conducted to analyze the physico chemical properties and planktons community of the pond and lake water. The main purpose of the present study was to identify the primary production and fish production patterns in village ponds and lake under different management practices.

II. REVIEW OF LITERATURE

Reviewing the literature is a pre-requisite of any research work that establishes a theoretical framework for the concerned topics or research areas. This helps the researchers to get well acquainted with the work done in the past on the similar fields in order to analyze the results of the present study accurately. This enables the researcher to distinguish and compare the present work done with that of the past. Water quality management principles in fish culture have been reviewed to make aware the fish culturist and environmentalist about the important water quality factors that influence health of a pond and are required in optimum values to increase the fish yields to meet the growing demands of present day scenario of the world, when the food resources are in a state of depletion and the population pressure is increasing on these resources.

Moyle (1946) suggested 40 ppm of alkalinity as a natural separation point between soft and hard water.Singhal *et al*. (1986) studied the physico-chemical environment and the plankton of managed ponds in Haryana, India. The physico-chemical parameters of water at Central Inland Fisheries Research Institute, Karnal. were measured monthly. They observed the fluctuations in water temperature in the ponds at Karnal. The major physico-chemical fluctuation at Karnal were the alternation between the dry season high concentrations and the relatively lower wet season concentrations of major chemicals. This fluctuation is caused by the annual rainfall being restricted to a few contiguous months, coupled with a high evaporation rate.Hutchinson (1975) suggested that the physico-chemical properties of water are important determinants of an aquatic ecosystem although they are greatly influenced and modified by climate and riparian vegetation.

Nandini(1999)studiedthe variations in physical and chemica1 parameters and p1ankton cornmunity structure from urban-based sewage stabilization ponds in Delhi. The quantified physico-chemical variables were temperature, pH, dissolved oxygen, soluble reactive phosphorus, total phosphorus, nitrate-nitrogen and chlorophyll-a. A qualitative analysis of the phytoplankton in all the ponds was made. Among zooplankton, rotífers, cladocerans, and copepods were identified and quantified. Observations were taken every month concentrations of soluble reactive phosphorus, total phosphorus and nitrate-nitrogen ranged between 1.2-2.0 mg L^{-1}, 2.0-3.5 mg L^{-1}, and 0.075-0.30mg L^{-1}, respective1y. As the water passed through the series of ponds, the quality improved and finally supported high zooplankton densities. There were summer blooms of *Euglena, Pandorina, Spirulina* and *Oscillatoria*. The commonly found rotifer species were *Calyciflorus, Hexarthra mira* and *Filinia longiseta*. Cladocera and Copepoda were represented almost exclusively by *Moina macrocopa* and *Mesocyclops thermocyclopoídes* respectively.

Bhatnagar and Sangwan (2008) studied the one of the sacred water tank Brahmsarovar, Kurukshetra (India) to assess the impact of mass bathing during new moon day (called as Amavasya in India) in terms of physico-chemical and biological characteristics. Overall water quality index was calculated using online calculator. A sharp and significant increase in ammonia concentration was also observed which is again due to high organic matter. No significant variation in plankton population was observed, however, numerical value of species diversity index showed a decrease indicating the elimination of sensitive taxa. Since the conditions are not beyond the limit so proper legislative efforts to disinfect the water regularly and to educate the pilgrims can improve it. Further, Bhatnagar *et al*. (2009) studied the water quality indices and abiotic characteristics of western Yamuna canal in Yamunanagar, Haryana. DO and BOD were found to be two important parameters which showed strong correlation with other parametersand hence can serve as good indices of river water quality. Thus the hydro biological conditions were not congenial, optimum for the survival and production of sensitive fish fauna. Therefore, proper and efficient treatment of the effluents and sewage should be carried out before discharging these into the canal.

Bhatnagar and Singh (2010) studied the primary production and fish production patterns in village ponds under different management practices. With a more or less narrow range of primary production, varying fish production and growth rates were recorded, indicating the influence of a combination of environmental and management factors. Sudden and considerable fluctuations in dissolved oxygen concentration and pH impair the proper functioning of other trophic communities, supported the dominance of decomposition processes, i.e., anaerobiosis, and lead to further degradation and loss of the control functions of the whole water ecosystem. Increased organic load can be considered as a general signal of reaching the instability of aquatic ecosystem and decrease of production efficiency.

The optimum fish production is totally dependent on the physical, chemical and biological qualities of water to most of the extent which was observed by Bhatnagar and Devi (2013). Hence, successful pond management requires an understanding of water quality. Water quality is determined by variables like temperature, transparency, turbidity, water colour, carbon dioxide, pH, alkalinity, hardness, unionised ammonia, nitrite, nitrate, primary productivity, BOD, plankton population etc. Shrivastava and Kanungo (2013) studied the physico-chemical parameters of Pond Water of Surguja, District Chhattishgarh, India. They observed the parameters which were taken to study the water quality are below the pollution level which satisfies the requirement for the use of various purposes like domestic, agricultural, industrial etc. But in case of surface water, the water quality of small community pond are above the permissible limit, it is found that some of the water samples are non-potable for human being due to high concentration of one or the other parameter.

Impact of environmental parameters on fish condition and quality in Lake Edku, Egypt observed by Saeed (2013). They observed that the most important environmental parameters affecting water characteristics, fish condition and quality in Lake Edku were water temperature, nutrients and drainage water discharged into the lake. Singh *et al*. (2016) observed the fish yields in relation to water quality and plankton production in managed and unmanaged fresh water ponds they observed that the managed and unmanaged extensive culture fisheries systems in small village pondsin the district of Kurukshetra, Haryana, India were explored and analyzed focusing on therelationship amongst water quality, production of fish food organisms, fish yields and managementactions. In unmanaged ponds, fish growth/yield and dissolved oxygen were low and ammonia,chlorides, calcium, total hardness, magnesium, phosphates and biochemical oxygen demand were higher when compared against managed ponds. The differences were likely due to higher organicload in the unmanaged ponds arising from domestic sewage and cattle entry from non-pointsources. Variations observed in the phytoplankton population for the unmanaged and managedponds were insignificant, however, zooplankton were high in unmanaged ponds. The NPP washigher in the unmanaged ponds in contrast to managed ponds.

The present work was thus carried out for evaluating the quality of water and planktons in the water of Karna Lake and a village pond (Taroari) of Karnal district.

III. MATERIALS AND METHODS

Study area

The study was conducted at Town Taraori, District Karnal and Karna lake, Karnal of Haryana State. Karnal is situated at the southern bank of the Yamuna Canal at 29.45 N latitude and 77.0 E longitude in the Karnal district of Haryana State, approximately 252 m above the sea level. The climate of Karnal is more or less tropical with only 3 seasons-winter, summer and rainy. The winter season starts in November, whereas, the summer and rainy seasons begin in March and July, respectively. The studied Taraori pond has approximately 1.9 m depth and Karna lake Karnal has approximately 2.2 m depth. The study was done after interval of 20 days during the months of February and March 2019.

The surface water of each pond was collected from 3 different sites separately in cleaned plastic bottles. For estimation of dissolved oxygen, the water sample was collected on the same day of the experiment for the estimation of accurate dissolved oxygen.

Analysis of Physico-chemical properties:

Dissolved Oxygen (DO)

Oxygen combines with divalent manganous hydroxide to form higher hydroxides, which on acidification liberate iodine equivalent to that of oxygen fixed. This iodine is titrated by standard solution of sodium thiosulphate using starch as an indicator.

For estimation of dissolved oxygen, water sample was collected in 250 ml stoppered bottles, avoiding entrapping of the air bubbles. Bottles were kept submerged and stopper was removed thereafter immediately and 2 ml each of manganous sulfate (solution A) and alkaline iodide azide solution (solution B) was dispensed with the help of pipette well below the surface of water and shaken properly. Then, precipitates were allowed to settle and thereafter dissolved by addition of 2 ml of concentrated sulphuric acid. DO (mg L^{-1}) was estimated by titrating 50 ml of aliquot against sodium thiosulphate (0.025N) till pale straw color appeared, then two drops of starch solution (1% freshly prepared) was added to it and titrated further until blue color disappeared.

$$\text{DO in mg L}^{-1} = \frac{8 \times 1000 \times \text{N}(0.025) \times \text{V}'}{\text{V}}$$

Where,
V = Volume of water sample taken (ml)
V´ = Volume of titrant used (ml)
N = Normality of the titrant (N)

pH

pH indicatorwhen mixed with water gives specific colors depending upon the pH of the sample. The color so produced is compared with the standard color chart.

For estimation of pH, 5 ml of water sample was taken in each test tube (in replicate of two). 2 drops of phenolphthalein indicator was added in each test tube, shaken gently. After 2 minutes color was developed in sample, matched the color with standard color chart provided with the indicator bottle. Recorded the corresponding pH value**.**

Alkalinity

Carbonate and bicarbonate alkalinity were estimated titrimetrically using phenolphthalein and methyl orange indicators, respectively. To 50 ml of sample in Erlenmeyer flask, 2 drops of phenolphthalein indicator were added. If color changed to pink, titration was done with $0.02NH_2SO_4$ to a colorless end point (A). If the sample remained colorless on the addition of indicator, it revealed that carbonates are absent. In the sample, 2-3 drops of methyl orange indicator were added and it was further titrated against 0.02N H_2SO_4 till the color changed from yellow to orange (B).

$$\text{Phenolphthalein alkalinity (Carbonate alkalinity)(mg L}^{-1}) = \frac{\text{ml of titrant A}}{\text{ml of sample}} \times 100$$

$$\text{Total alkalinity (mg L}^{-1}) = \frac{\text{ml of titrant B}}{\text{ml of sample}} \times 100$$

Chloride

Chloride is titrated with soluble silver nitrate in the presence of chromate, yielding precipitates of silver chloride. At the end, when all the chlorides get precipitated free silver ions react with chromate to form silver chromate of reddish-brown color.

Chlorides were determined by argentometric titrimetric method (APHA, 1998). 50 ml of the sample was taken in a conical flask; 5 drops of potassium chromate solution (5%) were added (yellow color) and titrated against 0.014N $AgNO_3$ until a brick red color appeared.

$$\text{Chlorides (mg L}^{-1}) = \frac{\text{ml of titrant used} \times \text{N} \times 35.5 \times 1000}{\text{ml of sample}}$$

N = Normality of the titrant (0.014 N)

Total ammonia (NH_3-N)

The ammonium ions reacted with alkaline solution of Nessler's reagent (Potassium mercury iodide) to form a yellow brown colored complex of ammonium mercury iodine. The light absorption was measured at wavelength of 425 nm.

50 ml of filtered water sample was taken in Erlenmeyer flask. 2 drops of Rochelle salt (sodium potassium tartarate) solution were added and mixed well. 2 ml of Nessler's reagent was added. After 10-20 minutes (color development) the absorbance was noted at 425 nm.

The concentration of NH_4-N was deduced from the standard curve prepared by dissolvingNH_3Cl in distilled water to prepare standard ammonia solution of 1.0 mg L^{-1} (concentrations 0.2-1.0 mgL^{-1}).

Orthophosphate (soluble reactive phosphorus)

The orthophosphate (o-PO_4) react with an acidified ammonium molybdate solution and form molybdophosphoric acid, which was then reduced to a blue complex in the presence of stannous chloride. Intensity of blue color was noted at 690 nm on spectrophotometer.

25 ml of water sample was taken in a conical flask (100 ml). Distilled water was used as blank. 1 ml of ammonium molybdate solution was added followed by 3 drops of stannous chloride solution (freshly prepared) and was shaken well. Blue color appeared, after 10minutes the absorbance was recorded at 690 nm. The value of o-PO_4 (mg L^{-1}) was deduced with help of standard curve prepared by using standard phosphate solution of 1.0 mg L^{-1} (concentration 0.2-1.0 mg L^{-1}).

Free CO_2

Free CO_2 reacts with strong alkali (such as NaOH) to form bicarbonates. Completion of reaction is indicated by development of pink color.

2 drops of phenolphthalein indicator were added in 50ml of water sample (if pink color developed then it was concluded that free CO_2 was absent). If the solution remained colorless, then it was titrated using standard NaOH (0.02N), until a slight pink color appeared and end point was recorded. Three concordant readings of each sample were taken and their mean was labelled as final value.

$$\text{Free Carbon dioxide mg L}^{-1} = \frac{\text{Volume of titrant used in ml}}{\text{Volume of sample taken in ml}} \times 1000$$

Total Hardness

Erichrome Black-T forms wine red complex with metal ions (Ca^{++} and Mg^{++}). The disodium salt of EDTA has a strong affinity towards Ca^{++} and Mg^{++}, therefore, by addition of EDTA, the complex is broken down and a new complex of blue color is formed.

1ml of ammonia buffer and 5 drops of Erichrome Black-T was added to 50ml of water sample. Color of the water sample would turn wine red. Titrated against EDTA solution, until a blue color appeared. Recorded the end point. Three concordant readings of each sample were taken and their mean was labeled as final value.

$$\text{Total Hardness mg L}^{-1} = \frac{\text{Volume of EDTA used in ml}}{\text{Volume of sample taken in ml}} \times 1000$$

Nitrate-nitrogen ($NO_{3-}N$)

The nitrate reacts with phenol disulphonic acid to form nitro acid complex which gives yellow color with strong alkali, which is spectrophotometrically determined at 410nm.

Evaporated 25ml of water sample to dryness on a hot plate. 0.5 ml of phenol disulphonic acid added and dissolved the residue using a glass rod. Added 5ml of distilled water and 2 ml 12 N KOH. Shaken and waited for 5-10 minutes. A yellow color will developed. After 10 minutes the absorbance was recorded spectrophotometrically at 410nm. The value of NH_3-N (mg $L^{-1)}$ was deduced with the help of standard curve prepared by using standard potassium nitrate solution 1.0 mg L^{-1} (concentration 0.2-1.0 mg L^{-1}).

Determination of Plankton Density

25L water samples were collected from five different sites (5L from each site) of each pond (Karna lake and Taraori pond). The total volume was passed through plankton net of 100 µm mesh size. Following this the filtered samples were transferred into a measuring cylinder to make 50 ml volume using distilled water. Finally, this was preserved in a solution of 4% buffered formalin using small plastic bottles. Planktons were identified using light microscope and then classified into different categories i.e. phytoplanktons and zooplanktons.

IV. RESULTS

Mean values of different physico-chemical parameters (Mean + SE) after an interval of 20 days for two months are shown in Table 1 and 2. The pH in both the ponds was found to be alkaline throughout the studied period. Alkalinity of taraori pond was found to be higher that of karna lake. Dissolved oxygen ranged from 4-5 mg L^{-1} in Taraori pond whereas in Karna lake ranged from 6-7.5mg L^{-1}. Chloride content was almost similar of both the studied ponds.

Alkalinity of Karna Lake was found to be lesser than that of Taraori pond. Free CO_2 of Taraori pond ranged from 38 to 40 mg L^{-1} and that of Karna lake ranged from 37 to 47.5mg L^{-1}. Nitrate and Ammonia content of Karna lake ranged from 0.20 to 0.44 mg $L^{-1}$and 1.22 to 1.6mg L^{-1} respectively and of Taraori pond ranged from 1.25 to 2.5mg L^{-1} and 1.3 to 2.4 mg L^{-1} respectively. Salinity of both the studied sites was almost similar ranges from 0.2 – 0.3 ppt.

Phytoplanktons of chlorophyceae, desmidiaceae and cyanophyceae classes were found i.e. *Spirogyra, Zygnema, Cosmarium,, Genicularia* and *Spirulina* respectively.

Zooplanktons of protozoa, rotifera, cladocera, crustacean, copepoda and ostracoda classes were found i.e. *Frontonia, Keratella, Brachionus, Bosmina,Alonella, Acroperus, Eurycerus, Eubranchipus, Diaptomus, Diaphanosoma* respectively.

Phytoplanktons were found in less number as compared to Zooplanktons in water sample of both the studied sites.Zooplanktons in water sample of Karna lake was found to be less than that of Taraori pond.

Table 1: Physico-chemical parameters of water sample of Karna lake.

Parameters	Mean± standard error		
	(1)	(2)	(3)
Hardness(mg L^{-1})	180.67±14.5	170.68±13.34	180.74±12.67
Free CO_2(mg L^{-1})	47.27±1.11	39.34±1.12	38.23±1.11
Alkalinity(mg L^{-1})	170.64±12.19	180.72±13.19	170.22±13.17
Dissolved Oxygen(mg L^{-1})	6.4±0.09	7.0±0.094	6.9±0.06
Chloride(mg L^{-1})	14.06±28.20	12.8±28.20	14.7±25.6
Nitrate-Nitrogen(mg L^{-1})	0.26±1.28	0.34±1.31	0.23±0.14
Ammonia-Nitrogen(mg L^{-1})	1.22±1.23	1.43±1.30	1.3±0.45

O-PO$_4$(mg L^{-1})	0.013±0.012	0.019±0.014	0.3±0.00
Salinity(ppt)	0.2±0.00	0.2±0.00	0.3±0.00
pH	7.5±0.00	8.0±0.00	7.5±0.00

Table 2: Physico-chemical parameters of water sample of Taraori pond.

Parameters	Mean± standard error		
	(1)	(2)	(3)
Hardness(mg L^{-1})	340.67±14.5	350.68±13.34	340.74±12.67
Free CO$_2$(mg L^{-1})	37.27±1.11	40.34±1.12	38.23±1.11
Alkalinity(mg L^{-1})	470.64±12.19	480.72±13.19	470.22±13.17
Dissolved Oxygen(mg L^{-1})	4.4±0.09	5.0±0.094	4.9±0.06
Chloride(mg L^{-1})	49.06±28.20	48.8±28.20	48.7±25.6
Nitrate-Nitrogen(mg L^{-1})	1.26±1.28	2.34±1.31	1.23±0.14
Ammonia-Nitrogen(mg L^{-1})	1.22±1.23	1.43±1.30	2.3±0.45
O-PO$_4$(mg L^{-1})	0.013±0.012	0.019±0.014	0.3±0.00
Salinity(ppt)	0.2±0.00	0.2±0.00	0.3±0.00
pH	7.5±0.00	8.0±0.00	7.5±0.00

V. DISCUSSION

Fish do not like any kind of changes in their environment. Any change adds stress to the fish and the larger and faster the changes, the greater the stress. So the maintenance of all the factors becomes very essential for getting maximum yield in a fish pond. Good water quality is characterized by adequate oxygen, proper temperature, transparency, limited levels of metabolites and other environmental factors affecting fish culture.

Dissolved oxygen of Karna Lake indicated that water quality is good for fish production. This may be due to boating. Low dissolved oxygen of Taraori pond indicated that pond water was polluted, sewage waste and domestic waste discharged into this water without any treatment. Chopra *et al.* (2009) have also reported that increased industrial activities and sewage from point and non-point sources results in low dissolved oxygen. According to the Central Pollution Control Board (CPCB, 2000), 70% of the pollution in rivers is from untreated sewage, which results in low DO and high BOD (Khaiwal *et al*., 2003). Bhatnagar *et al*. (2004) DO level greater than 5 mg L^{-1} is essential to support good fish production. Bhatnagar *et al*. (2004) also suggested that 1-3 mg L^{-1} has sublethal effect on growth and feed utilization; 0.3-0.8 mg L^{-1} is lethal to fishes and greater than 14 mg L^{-1} is lethal to fish fry and gas bubble disease may occur. DO less than 1 causes death of Fish, less than 5 mg L^{-1}, Fish survive but grow slowly and will be sluggish, 5 mg L^{-1} and above is desirable.

pH of both the studied site was ideal for fish production and for other aquatic micro organisms. Ideal pH level is between 7.5 and 8.5 and above and below this is stressful to the fishes. Ideally, an aquaculture pond should have a pH between 6.5 and 9 (Wurts and Durborow, 1992; Bhatnagar *et al*., 2004). According to Santhosh and Singh (2007) the suitable pH range for fish culture is between 6.7 and 9.5.

Nitrate content of both the was also found to be desirable for fish production and other aquatic organisms. According to Stone and Thomforde (2004) nitrate is relatively nontoxic to fish and not cause any health hazard except at exceedingly high levels (above 90 mg L^{-1}). Santhosh and Singh (2007) described the favourable range of 0.1 mg L^{-1} to 4.0 mg L^{-1} in fish culture water. Free CO_2 of the both the site is high. Burggren (1979) high free CO_2 affects respiration of aquatic organisms and slows the rate of metabolism of fishes. High CO_2 in the present investigations perhaps, may be one of the factor influencing fish survival, production and reproduction. Boyd and Lichtkoppler (1979) fish avoid free CO_2 levels as low as 5 mg L^{-1}. Most species can survive in waters containing up to 60 mg L^{-1} carbon dioxide, provided DO concentrations are high. Bhatnagar *et al*. (2004) suggested 5-8 mg L^{-1} is essential for photosynthetic activity; 12-15mg L^{-1} is sublethal to fishes and 50-60mg L^{-1} is lethal to fishes. The free carbon dioxide in water supporting good fish population should be less than 5 mg L^{-1} (Santhosh and Singh, 2007). Presence of free CO_2, may be responsible for releasing of phosphate ions into surroundings from its insoluble compounds like ferric sulphate as supported by Wetzel (2001).

Chloride content of Taraori pond was high, it may be due to the presence of pollutants in the water. According to Stone and Thomforde (2004) the desirable range of chlorides for commercial catfish production is above 60 mg L^{-1}. Alkalinity of Karna lake found to be in range i.e. optimal for fish production and other aquatic organisms and that of Taraori pond was higher than the optimal range. This may be due to the presence of bicarbonates. This is due to washing of clothes and bathing of cattles. Bhatnagar *et al*. (2004) suggested that less than 20 mg L^{-1} indicates poor status of water body, 20-50mg L^{-1} showed low to medium, 80-200 mg L^{-1} is desirable for fish/prawn and greater than 300 ppm is undesirable due to non- availability of CO_2.

Ammonia occured naturally by the breakdown of waste/sludge i.e. fish food and excrement and plants. Ammonia content of both the sites found to be greater than the optimal range. This greater concentration might be due to inadequate or immature biological filteration. Bhatnagar *et al*. (2004) suggested 0.01-0.5 mg L^{-1} is desirable for shrimp; greater than 0.4 mg L^{-1} is lethal to many fishes & prawn species; 0.05-0.4 mg L^{-1} has sublethal effect and less than 0.05 mg L^{-1} is safe for many tropical fish species and prawns. Bhatnagar and Singh (2010) recommended the level of ammonia (less than 0.2 mg L^{-1}) suitable for pond fishery.

Salinity of both the studied site found to be in optimum range. Salinity is a major driving factor that affects the density and growth of aquatic organism's population (Jamabo, 2008). Garg and Bhatnagar (1996) have given desirable range 2 ppt for common carp; however, Bhatnagar *et al*. (2004) gave different ideal levels of salinity as 10-20 ppt for *P. monodon*; 10-25 ppt for euryhaline species and 25-28 ppt for *P. indicus*. Barman *et al*. (2005) gave a level of 10 ppt suitable for *Mugil cephalus* and Garg *et al*. (2003) suggested 25 ppt for *Chanos chanos* (Forsskal).

Hardness of Karna lake found to be in optimal range and that of Taraori pond is higher than that of optimal range. Hardness is due to the presence of calcium and magnesium carbonate. This high level of hardness may be due to domestic sewage which are directly discharged into the water without any treatment. According to Bhatnagar *et al*. (2004) hardness values less than 20ppm causes stress, 75-150 ppm is optimum for fish culture and greater than 300 ppm is lethal to fish life as it increases pH, resulting in non-availability of nutrients. The phosphate value of Taraori pond is higher than that of Karna lake. Bhatnagar *et al*. (2004) suggested 0.05-0.07 ppm is optimum and productive; 1.0 ppm is good for plankton and shrimp production.

Chlorides, phosphates and ammonia were high in Taraori ponds in comparison to Karna lake, though no fertilizers were added in wild ponds. Pond sediment also showed high level of organic pollution depicting high accumulation of organic carbon and nitrate in the pond sediment. This increase in these parameters in the wild ponds might be because of unmanaged entry of cattle and domestic waste coming from non-point sources, since these parameters are usually taken as an indicator of pollution (Bhatnagar and Sangwan, 2009; Garg and Bhatnagar, 2000, 2003, 2010). Alkalinity and pH have direct effect on the orthophosphate concentration in water. A decrease in carbon-dioxide resulting from photosynthesis or gaseous diffusion, increases pH and cause phosphate precipitation (Hepher, 1966). Dissolved oxygen is considered, significant both as regulator of metabolic process and indicator of water quality.

The zooplanktons were significantly higher in wild ponds, no significant variation of phytoplankton found in Taraori pond and Karna Lake. Plankton production is dependent on variables such as the carrying capacity of the environment, available nutrients and oxygen supply. These variable scan have direct influence on the production levels of fish food organisms. The interface of the phytoplankton-zooplankton is the vital zone where alterations in the type and number of predators on top of the food web changes based on deviations in the ecosystem properties including primary productivity and recycling of nutrients.

VI. CONCLUSION

From the findings of this study it can be stated that fish production appears to be dependent to a lesser magnitude on the scale of primary productivity. Pond water of Taraori was found to be polluted because of discharge of sewage waste, domestic waste, industrial waste into this water. Karna lake water was not so polluted as Taraori pond and dissolved oxygen was also optimum of that water due to boating. The universal relationship among the primary productivity levels and fish productivity was not supported as a range of variables such as ammonia production, organic load and quantity and quality of fertilizers affect such relationships. For aquaculture at small levels in village ponds, the fish production can be effectively enhanced through controlling the quality of water quality by managing the waste input at optimized levels. There is a need to carry out such studies in village ponds for different agro-climatic conditions. Studies should also be carried out by optimizing the waste input in village ponds to manage the water quality. Evaluation of the successive limiting factors is also necessary as this may impede the increase of fish production.

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