



## LIMNOLOGICAL STUDY ON 2 PONDS WITH SCIENTIFIC MANAGEMENT FOR IMPROVED FISH CULTURE, LNMU CAMPUS DARBHANGA, BIHAR

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### ABSTRACT :

*The seasonal variations in some essential physicochemical parameters and biological analysis of the Darbhanga three rural pond, Bihar, by selected normal classical methods to research the conditions for better use. The data gathered in different seasons (summer, winter and rain) showed that the parameters evaluated were within the permissible limit for fish crops and that water productivity should be stored. Whereas statistical analyses of the findings reveal substantial environmental changes related to these ponds' physical and chemical environments. Our study emphasises local people's participation and education in sustainable waste disposal. Our BOD study for the ponds is under the group of moderately contaminated ponds that should be solved for better productivity in future.*



**KEYWORDS :** Dharbhanga physico-chemical; rural lake;

### INTRODUCTION :

The use of freshwater resources for the healthy production of human society are agricultural, commercial, home, leisure, environmental. In reality, cool water supplies are very useful to our planet's lives. In recent years there was a large rise in the number of dams, reservoirs, tanks etc. In these freshwater resources, the creation of fishery is presently needed by scientific techniques. Limnological surveys on bodies of water have usually been evaluated to assess water bodies' contamination levels sometimes. The water's abiotic and biotic influences depend on the quality and quantity of aquatic life. Not only human, but also the various species living in the water, have a unique role to play in nature. Freshwater bodies are distinguished by temperature, geochemical, geological morphology and contamination physical and chemical characteristics. It is very important to research physical and chemical factors that affect biodiversity in aquatic bodies in the goal of efficient utilisation of fresh water bodies for fish manufacturing (Sahni and Yadav, 2012). The level of aquatic life that survives in a pond depends entirely on the pond's water quality. There are not much information about Physical-Chemical and Biological parameters in existing waterbodies in recent years (Yadav et al., 2013) [20,23].

For all kinds of lives in this country, water is the most valuable resource. With this in mind, concerns arose for the existence of freshwater in the distant past. Freshwater phenomena were noted and reported during Forel (1841 – 1912) considered the founder and father of limnology. Limnology is the science field that discusses the biological productivity of internal waters with all their causal influences[1]. In Le Lemane (Lake Geneva), Forel 's groundbreaking 1982 investigations based on the preliminary facts concerning the fauna of freshwater. Then limnology, particularly plankton, was studied for organisms[1]. Victor Hansen's

1887 discovery of plankton was an extraordinary occurrence in the area of limnology. The first limnological studies were conceivably performed by Prasad in India on the seasonal variation of pond organisms[2].

Curiosity encourages scientists to learn the truth of limnology, and therefore study has occurred periodically on various aquatic bodies. Certain scientists have addressed the distribution of biological conditions and others observed the interrelationship between certain factors for the growth and development of zooplankton and fish in detail about the physical-chemical conditions of a specific aquatic body. Stress was also put on the algal blooms by the researchers[3, 4].

## MATERIAL AND METHODS

Three ponds in various residential areas of Dharbhanga, specifically Pond 1 (Amra Talab), Pond 2 (Shershah Tomb Pool) with cemented embankments and Pond 3 (Salim Khan Tank). Monthly sample sampling of different abiotic parameters (temperature, transparency, pH, oxygen dissolving, free CO<sub>2</sub>, complete alkalinity, BOD) and biotic was performed in all three ponds from June 2011 to May 2012. APHA (1998) was used to carry out physico-chemical analyses of the water samples[10,23].

Samples were obtained with the aid of a 1 litre mug to estimate the planktonic population. The plankton net of bolting silk no. 25 (0.064 mm mesh size) was collected for 50 litres of water and 2-4 % formalin for further analysis was retained. The sample plankton sample is collected.

For comparison of seasonal variations the data collected were grouped into three categories: summer (February-May), winter (October-January), and rainy (June-September).

Bihar was examined by Narayana et al. from June 2011 until May 2012 in twenty five ponds in three Araria district blocks[8]. The pH, temperature, transparency, free CO<sub>2</sub>, dissolved oxygen, complete alkalinity and complete dissolved solids were the physical and chemical properties investigated. The pH of the water was found to be little alkaline and has been confirmed by the Central Pollution Control Board of New Delhi [7]. However, over the rainy season, total alkalinity rose. This is largely due to bio-organism decomposition. The higher TDS values may be attributed to the release of domestic waste water and waste in the tanks in the rainy season. Further, in the group B or C of water quality requirements of the Central Pollution Control Board, New Delhi, the DO values for different tanks suggested that the water is safe to bathe and even drink after conventional treatment[7].

Sinha et al.[10,19] concluded that both aquatic bodies suffered from eutrophication from the water quality evaluation of two pools in the Dharbhanga district of Bihar. The eutrophic status of water bodies was indicated by the high biochemical oxygen demand, low dissolved oxygen and high nitrate level. The higher sulphate levels have demonstrated the inadequacy of domestic use.

Study Area: A general survey of the fish culture ponds in different districts of

## RESULTS AND DISCUSSION

Table-1 displays the morphological characteristics of the three ponds studied in this study. The lakes are located in different Bihar residential areas, namely, pond 1 (Amra Talab), pond 2 (Shersha Grave Teacher) and pond 3 (Salim Khan Tanks). Pool 1 and 2 have cemented bottoms while Pond 3 (Salim Khan Tank) has earthen bottom where marginal weeds have significantly infested the pond. All three ponds are permanent, non-drainable, toilet, laundry and utensils. Regularly, large quantities of milk waste from adjacent cowsheds are disposed in ponds 2 and 3. Table 2 showed the physico-chemical study in these ponds in different seasons[20,21].

**Table 1: Morphology of the pond**

Pond No.	Shape	Embankment	Water spread area(ha)	Bottom	Mean depth(m)	Macrophyte infestation
1.	Square	Cemented	1.0	Muddy	4	Nil
2.	Square	Cemented	13.0	Muddy	6	Scanty
3.	Rectangular	Earthen	8.5	Muddy	3	50% area

**Table 2: Information of the ponds' physico-chemical and biological parameters**

S.N.	Parameter	Pond1			Pond2			Pond3		
		summer	Rainy	Winter	summer	Rainy	Winter	summer	Rainy	Winter
1.	Air temperature	31.47± 2.0	27.3± 2.1	25.2± 2.1	31.47± 2.0	27.3± 2.1	25.3± 2.1	31.47± 2.0	27.3± 2.1	25.3± 2.1
2.	Water temperature (°C)	27.4± 0.8	24.4± 1.5	22.9± 1.5	27.4± 0.8	24.4± 1.5	22.9± 1.5	27.4± 0.8	24.4± 1.5	22.9± 1.5
3.	pH	8.5± 0.4	8.0± 0.3	7.85± 0.25	8.5± 0.4	8.0± 0.3	8.5± 0.4	8.5± 0.4	8.0± 0.3	8.5±0.4
4.	Dissolved oxygen (ppm)	8.7± 0.4	9.6± 0.3	9.5± 0.2	8.7± 0.4	9.6± 0.3	9.5± 0.2	8.7± 0.4	9.6± 0.3	9.5±0.2
5.	Free carbon dioxide (ppm)	16±2.0	18±3	20±3	16±2.0	18±3	20±3	16±2.0	18±3	20±3
6.	Alkalinity(ppm)	190±5	220±3	202±3	190±5	220±3	202±3	190±5	220±3	202±3
7.	Secchi disc transparency(cm)	28.5± 1.5	36± 3.0	29.5± 2.0	28.5± 1.5	36± 3.0	29.5± 2.0	28.5± 1.5	36± 3.0	29.5± 2.0
8.	Hardness(ppm)	118±8	90±5	103± 2.5	118±8	90±5	103± 2.5	118±8	90±5	103± 2.5
9.	conductivity	2.64± 0.5	2.83± 0.5	2.42± 0.6	2.64± 0.5	2.83± 0.5	2.42± 0.6	2.64± 0.5	2.83± 0.5	2.42± 0.6

10.	Total dissolved solids (ppm)	165± 10	172± 8.0	154± 6.0	165± 10	172± 8.0	154± 6.0	165± 10	172± 8.0	154± 6.0
11.	Biological oxygen demand (ppm)	2.81± 0.4	2.82± 0.5	2.21± 0.6	2.64± 0.5	2.82± 0.5	2.21± 0.6	2.64± 0.5	2.82± 0.5	2.21± 0.6
12.	Plankton (ml 50l)	0.3	0.25	0.3	0.3	0.25	0.3	0.3	0.25	0.3

### TEMPERATURE

Temperature plays an important role in the marine ecosystem and is an important factor in water management. (Singh and Mathura, 2005). (Wetzel, 1975; Dwivedi and Pandey, 2002. [19,22] In the present study, an easonal variation of air and water temperatures was observed. The temperature of the air varied between 25o C and 31o C, while the temperature of the water ranged between 23.0oc and 27o c. It was comparatively less during the season, during the moonsoon and less in the winter. The same findings as those observed in the present research were also noticed by Kannan and Job (1980).

In all the three ponds there was no improvement in the temperature. Though, the minimum temperature reported during December (160C) is also within the permitted limit of the fish cultivated, tempering ratings reflect the suitability for fish cultivation (Jhingran 1982). [8]. There are no substantial changes in water temperature due to the large size of the bodies. The pond 1 difference in the summer peak was very small compared to the pond 2 & 3 and may have a cemented terrain and a comparatively smaller scale in comparison[24].

### pH

pH is a limiting factor and functions as a general environmental index. There was an alkaline pattern in the pH of the bottle. The highest pH was in the month from April i.e.8.5 and at least 7.85 in October. Data indicate that the pH decreases in the rainy season, and in the summer.pH status on significant chemical parameters in the aquatic environment that predicts the appropriateness of fish cultivation. The alkaline pH is acceptable for cultivating fish (Jhingran, 1982).[8] The pH was more acceptable for washing cloths and less for disposing of bovine waste. Nevertheless, the pH overall was the same and the pH was little alkaline that is better suited for fish cultivation.

### Transparency

Water transparency at various trophic stages is a significant factor in the energy relationship. The transparency results ranged from 28 cm to 36 cm percentage of research. In the summer it was low and in the winter it was higher. Due to high planktonic population, transparency was lower in the summer season. Increased the hanging material carried into surface run-off was poor in the rainy season. The winter season saw maximal openness. Allocated to suspended matter sedimentation (Chaurasia and Adoni, 1985; Sinha et al., 2002; Kadam et al., 2007; Shah and Pandit, 2012).[9,20] Transparency plays an essential part in the production of nutrients and also suggests water productivity. Plancton supply affects water transparency. Water transparency. Owing to poorly diluted plancton during the rainy season, water was clear in the rainy season compared to the winter and summer months.

### Dissolve oxygen

The content of oxygen is important for the immediate needs of many species and affects the solubility of many nutrients and thus the periodicity of aquatic habitats (Wetzel, 1983). In Jhingran (1982)[8], the oxygen level in tropical waters is low given the high temperatures[22]. This study found that during the winter, 9.5 ppm less was reported during the rainy season, i.e. 8.5 ppm less. The highest peak value of dissolved oxygen was reported. Owing to high temperatures that decrease oxygen solubility, minimum dissolved oxygen is seen throughout the summer. In addition, higher temperatures increase decomposition and minimise oxygen findings close to those of other staff in the present study (Prasad et al. 1985; Ramulu and Benarjee2013)[16].

### Carbon dioxide

Standard water absorbs CO<sub>2</sub> from different sources, i.e. (1) the atmosphere. (2) Plant and animal breathing. (3) Organic matter's bacterial decomposition. (4) Ground water inflowing. Co-relationship between carbon dioxide and pH is accomplished by an increase in pH (acidic) carbon dioxide. The highest free CO<sub>2</sub> in the summer and the minimum during the rainy season have been recorded, varying from 16 to 20 ppm. The concentration of free carbon dioxide is affected by the breathing rate (plants and animals) and the photosynthesis rate. If the photosynthesis is more That is going to consume more carbon dioxide.

### Alkalinity

Bicarbonate and carbonate feature is alkalinity. Salt is hydrolyzed and hydroxyl ion is formed. It is also used as a productivity indicator of Water [8,6] (Jhingran, 1982; Hulyal and Kaliwal, 2011). The importance of natural water bodies in tropics typically differ widely based on their total alkalinity. The season and the geography. The overall alkalinity ranged from 190 ppm to 224 ppm in the present analysis. From July to September and then it gradually decreased The month of October increased. In the rainy and lowest summer seasons, the highest value has been observed. Rainy season raises overall alkalinity. The deterioration of the plant and organism and organic waste may also be one explanation for the rise in carbonate, bicarbonate and, as a result, alkalinities (Jain et al. 1997; Chaurasia and Pandey, 2007).[3,7] In the water, calcium carbonates were input and dissolved in water column (Padma and Periakali, 1999).

### Hardness

Hardness of water in the form of carbonates and sulphates is primarily due to Ca<sup>++</sup> and Mg<sup>++</sup> salts (Wadia, 1961)[21]. The overall water hardness ranged from one in the present study. In the summer and during the rainy season, 90-120 ppm were the highest value. Different workers have made similar observations (Kumar, 1995; High value in summer and lower in winter, found by Hulyal and Kaliwal (2011), Naik and Purohit, 1996; Kaur et al. 2000; Nair, 2002).[7,11,12,13] Hulyal and Kaliwal (2011). They have been attributed reduces the amount of water and raises the high-temperature evaporation rate. The hardness of the water is moderately (0-75 mg/l-1) (75-150 mg/l-1) hard, hard (150-300 mg/l-1) and over 300 mg/l-1 very hard, depending on the hardness level. The water from the current pond seems to be hard on the basis of the observation.

### Electrical conductivity

Electrical water conductivity ranged between 2,4mScm<sup>-1</sup> and 2,9mScm<sup>-1</sup> depending on the type and concentration of salt in high ionic concentrations, pollute, trophic concentrations, certain household effluents and other organic water (Ahluwalia, 1999) [1]. The electrical conductivity values showed a major seasonal difference during rain and winter. Various employees (Hulyal and Kaliwal, 2011; Ramulu and Benaryee, 2013) have observed similar findings [16].

### Total dissolve solids

Water is a universal solvent and has a large number, mostly physical-chemical, of salts dissolved

therein. Complete dissolved solids optimum value. In the rainy season 172 ppm were recorded and a minimum of 154 ppm was recorded in the winter. Due to the addition of domestic waste the high TDS value during rainy periods. In the natural surface water sources, water, waste and sewage etc.

### Biological oxygen demand

Dissolved oxygen of BOD is a micro-organism needed for the aerobic decomposition of organic matter found in water [7]. Essential parameter for assessing the status of pollution in aquatic environments. The analysis found that during rainy season the maximum BOD value was 3.2 ppm and during winter 2.21 ppm. Pond 1 was shifted, and pond 2 & 3 may be attributed to waste flowing from the catchment in the pond. In the late summer / early rainy season, the BOD was seasonally strongest. The presence of multiple microbes in waterbodies can be caused by high BOD in late summer / early rainy season, which accelerate their metabolic activity by raising organic matter concentrations in municipal and domestic waste that pours into the lagoon by run-off. Prasanna Kumari et al. (2003) also reported that organic waste input and increased bacterial activity also contributed to the higher levels of BOD during rainy season. By growing the temperature, high temperatures play an important role in oxidation. The BOD of unpolluted water is 2.00-9.00 ppm, whereas highly contaminated water has BOD greater than 10.00 ppm. In the current analysis, the BOD shows that the pool is moderately polluted in various seasons.

### Plankton

The concentration of plankton was between 0.1 and 0.3 ml/25 l of water. In the winter and in the summer months it was lower. For commercial fish farming, the concentration is low (Jhingran, 1982) [8].

### Statistical Analysis

All readings of different physico-chemical test parameters were made triple per month and seasons were used for calculating the mean and standard deviations using Excel 2013

### CONCLUSION

The observation of the various parameters showed that the physico-chemical and biological parameters for all three ponds, with the exception of plankton abundance, are within the allowable limit for fish culture. It may be because of storage or because more species feed on plankton. In order to achieve better efficiency, the pond may be stored on the basis of the natural productivity of the water or additional feeding (if possible). Our study stresses the need for local citizens to be active and educated about the safe disposal of effluents. Our BOD study of ponds comes under a moderately contaminated category that must be solved to increase production in the future.

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