Limnology of Baghel Taal, a Wetland of District Bahraich (U. P.)

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Abstract- ***The physic-chemical condition of water plays a vital role in the wetland ecosystem. The various physico-chemical parameters of water of Baghel Taal have been studied during July, 2018to June. 2019 to find out its impact on fish food production. Various physico-chemical factors viz,; temperature, transparency, pH, dissolved oxygen, free carbondioxide, total alkalinity, total hardness, nitrates and phosphate fluctuate within a range conducive to high biological productivity. Total 23 species of phytoplankton and 20 species of zooplankton were recorded. Bimodal pattern of seasonal variation of plankton was found, with a primary peak in the month of July and secondary peak in January. The physico-chemical and biological conditions were suitable for fish culture.***

Indexed Terms- ***Physico-chemical factors, plankton diversity, Wetland, Baghel Taal.***

I. INTRODUCTION

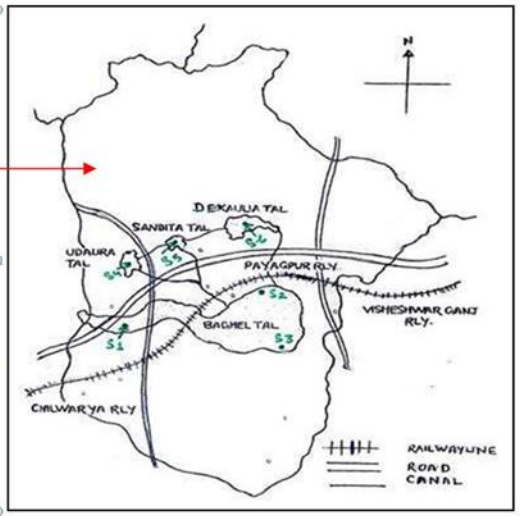
Wetlands are areas where water is primary factor controlling the environment and the associated plants and animal life. They occur where the water table is at or near the surface of the land, or where the land is covered by water. Wetlands are among the world's most productive environments. They are cradles of biological diversity, providing the water and primary productivity upon which countless species of plants and animals depend for survival. They support high concentrations of birds, mammals, reptiles, amphibians, fish and invertebrate species. Wetlands are important components of watersheds and provide many valuable functions to the environment and to society. The water resource is being used for various purpose such as domestic use, agriculture and fish culture etc. by local community. Now wetlands are shrinking rapidly because of urbanization and industrialization. Due to urbanization and anthropogenic pressure most of the wetlands are succumbed to greater degree of biologically active nutrient accumulation.

Limnology is derived from Greek word 'Lime'= lake; o-logy=study, meaning study of physical phenomenon of lake or taal or pond life. According to Hutchinson (1967), limnology is the study of whole sequence of geological, chemical and biological events that operate together into a pond, lake or stream basis and dependent on one another. The physico-chemical and biological conditions of the wetlands water can be used to assess the ecological nature of the wetlands. Although a large number of workers have studied the limnological parameters of lentic waterbodies of India (Singh, 1983; Goel, *et. al*; 1986; Singh, 1990; Abbasi, *et al*., 1996; Ansari and Prakash, 2000; Kumar *et al*., 2015) but till now there is no sufficient baseline data about limnological parameters of wetlands of U.P. Therefore, the present work has been undertaken for studying the limnological characteristics of Baghel Taal, A Wetland of Bahraich district of U.P in relation to agriculture and fish culture.

II. STUDY AREA

Baghel Taal is a large shallow perennial lentic waterbody with irregular margin and dense growth of macrophytes. It is situated in village Baghel, Payagpur block of district Bahraich at a distance of about 1.60 km. To the south - east of Payagpur Railway station. It is about 31 km, away from Gonda, 30 km, from Baahraich and 45 km from Balrampur.

Map of U.P. Showing District Bahraich



Location of Baghel Taal in Payagpur Block of Bahraich District

It is half oval in shape with maximum diameter of 3800m and connected with three small waterbodies namely Udavra Tal, Sandita Tal and Dekaulia Tal. It receives water from three main streams, Babia nallah from north-west side, Jamvar nallah from north and Sakarpatti nallah from north-east side during rainy season. It is also a Bird sanctuary extending around 32 km with total catchment area of wetland 441.5575 acre. Out of this only 121.22 acre is water body in rainy season but in summer its area becomes reduced with maximum depth 3.6m. It is habitat of rich micro- and macro living organisms including *Nymphaea, Nelumbo*, Narkul, Tinna rice, vegetation as well as various annelids, molluscans, fishes and amphibians. The abundant food attracts hundreds of resident and migratory birds including Siberian crane during winter season

Satellite view of Baghel Taal, Wetland in Bahraich District U.P.

III. MATERIAL AND METHODS

Water samples were collected fortnightly from three fixed sites in a plastic stoppered bottels, both from the surface and bottom layers between 8 to 10 A.M. The transparency, temperature, dissolved oxygen, free carbondioxide and pH were recorded on spot by using Secchi disc and water quality analyser kit. The total alkalinity, total hardness, nitrates, and phosphates analysis were made at field as well as in laboratory as per standard methods (APHA, 1998). In biological parameters, plankton productivity was measured by using Sedgewick Rafter plankton counting cell and quantities are expressed here as units per litre of the pond water. Plankton were identified with the help of a book entitled "A guide to the study of fresh water biology" written by Needham & Needham (1962) and other standard literature.

IV. RESULTS AND DISCUSSION

- Physico-chemical Properties of Taal water (Table1): Results of the physico-chemical attributes of the pond waters have been presented in Table1. The parameter wise results obtained are elaborated and discussed below-

Table 1. Monthly variations in Physico-chemical properties of Baghel Taal (July, 2018to June, 2019)

Months	Temp. (^{0}C)	Trans. (cm)	pH	DO. (ppm)	FCO_2 (ppm)	Total Alk.(ppm)	T H (ppm)	Nitrate (ppm)	Phosphate (ppm)
Jul	31,4	61.5	7.7	8.5	16.4	117.8	78	0.45	0.07
Aug	30.1	64.3	8.4	9.6	10.4	104.5	80	0.34	0.09
Sep	28.5	71.2	8.6	9.8	7.9	92.8	88	0.68	0.11
Oct	28.2	85.4	8.9	10.7	6.4	99,6	84	0.82	0.12
Nov	23.4	145.2	8.5	10.2	5.4	96.4	92	0.78	0.09
Dec	18.5	155.6	8.6	10.8	5,0	97.3	94	0.32	0.06
Jan	15.4	154.8	8.7	10.2	4.4	99.5	96	0.27	0.05
Feb	20.6	153.4	8.5	9.8	4.8	107.4	98	0.23	0.06
Mar	24.8	135.3	8.7	10.2	4.9	131.2	109	0.19	0.07
Apr	26.5	130.7	8.0	8.8	6.4	141.2	112	0.17	0.08
May	29.5	128.8	8.1	8.1	9.2	144.3	117	0.29	0.08
Jun	30.7	92.4	7.5	7.6	16.9	149.2	104	0.36	0.08
Ranges	15.4-31.4	61.5-155.6	7.5-8.9	8.1-10.8	4.4-16.9	92.8-149.2	78-117	0.17-0.82	0.05-0.12

- Water Temperature: Water temperature is responsible for not only high biological productivity but also influences the physiological activities of aquatic organisms. .The water temperature of taal ranged between 15.4^{0}C (January) -31.4^{o}C (July). The range of water temperature is suitable for culture of Indian major carps and exotic carps (Jhingran, 1988).In the present study maximum temperature was recorded during summer followed by rainy season whereas the minimum temperature was during winter months owing to greater intensity and longer duration of sun rays. Monthly variations noted in water temperature is a consequence of fluctuations in ambient temperature as the taal represent smaller body of water in comparison to lakes and river and more quickly react to changes in atmospheric temperature (Dhamija and Jain,1994; Joshi and Singh,2001). In the present water body no thermal stratification was observed and water at different layers was noted almost isothermal. The taal water is liable to fast wind action thus providing an opportunity for frequent stirring of the water enabling aeration at different columns and continuous replenishment of the upper water layer with nutrients thereby increasing productivity of the wetland.

- Transparency: The average depth at which Sachhi disc disappears and again reappears from open surface of water is called transparency of water. It is inversely proportional to the turbidity of water (Kumar *et al*., 2015). Water transparency controls the energy relationship at different trophic levels in food chain (Kumari and Jha 2015). Apparent changes (65.5-155.6 cm) were recorded in the transparency of the taal water during different seasons. Maximum transparency was noted during winter, low in summer and lowest in the rainy months. Maximum transparency recorded during winter months may be attributed to sedimentation of suspended matter as opined earlier (Chaurasia and Adoni, 1985). The reason for the summer turbidity was the bottom deposits brought into suspension by strong summer winds whereas during monsoon. Slight turbid water attributed to productive capacity of the taal.

- pH: pH is one of the most important parameters in water chemistry and is defined as negative logarithm of hydrogen ion concentration and measured as intensity of acidity or alkalinity on a scale ranging from 0-14. The pH is an indicator of overall environmental condition of the aquatic system. The pH of taal water ranged between7.5-8.9 which is suitable for aquatic life (Singh, 1990). The decline in pH values during summer is associated with the dissociation of carbonic acid (formed by surplus free carbondioxide) into H^+ and $HCO3^-$ ions. These H+ ions declined the pH of water in summer. Alkaline range of taal water are indicative of the fact that photosynthetic activity has dominance over the respiratory activity of the biota.

- Dissolved Oxygen: Dissolved oxygen of any water body is an important parameter because it is an indicator biological productivity of taal. The oxygen concentration in water body is a function of the temperature as well as the photosynthesis and community respiration. The range (8.1-10.8 ppm) of DO_2 shows that taal water was saturated with oxygen throughout the year. The highest dissolved oxygen was recorded during winter months may be attributed to low temperature which enables to hold more oxygen and partly to the luxuriant growth of macrophytes during these months. Hazelwood and Parker (1961) stated that, the highest dissolved oxygen in winter may be due to low atmospheric temperature and high photosynthetic activity. Oxygen depletion in summer months may be due to high temperature and rapid oxidation of organic matter. In aquatic ecosystem, oxygen plays a vital role as it regulates metabolic processes of both plankton and animal communities and is regarded as an indicator of aquatic productivity. The dissolved oxygen concentration above 5.0 ppm throughout the year shows that the wetland is very much productive (Ansari and Prakash, 2000). Thus regarding concentration of dissolved oxygen, Baghel taal falls in a productive group.

- Free Carbon dioxide: Free carbon dioxide in a waterbody is generally derived from the atmospheric sources, biotic respiration and decomposition of organic matter by saprophytes. In the present study the FCO_2 range was ranged between 4.4-16.9 ppm. The FCO_2 concentration in the taal was maximum during rainy months and minimum during winter months. The appearance of high concentration of free carbon dioxide during monsoon months could probably be associated with rapid decomposition of organic matter in the sediments owing to low depth, greater intensity and longer duration of sun light and ultimately more heat budget in the ecosystem. The present finding is similar to that of Kumar *et al*., (2015).

- Total Hardness: The hardness 0f water primarily depends upon salts of calcium and magnesium ions in water, mainly the carbonates and sulphates (Wadia, 1961). It is an index of fertility of the aquatic ecosystem. Moyle (1946) suggested 40 ppm of hardness as a natural separation point between soft and hard waters. The total hardness ranged between 78-117 ppm indicates that water of the taal is suitable for fish culture (Jhingran, 1988). The highest hardness was noticed in summer months and lowest in winter months. The peak value of total hardness present during summer in this study may be attributed to decrease in water level or volume and increased rate of evaporation at high temperature. Again, the present finding

suggests that the taal water is moderately hard. Since water with a hardness of up to 75mg/l is treated as soft from 75-150 mg/l moderately hard and 150-300 mg/l as hard and above that very hard (Kiran, 2010).

- Nitrate: The most chemically stable available form of nitrogen is nitrate. High nitrate concentration is responsible for algal blooms in water body. Surface runoff, decayed vegetations and animal matter are the main sources of nitrates in water body. The nitrate content of the water ranged between 0.17- 0.82 ppm. Its maximum concentration was observed in the post monsoon season. The result is supported by the findings of Khan *et al*. (1986).

- Phosphate: Phosphate is considered as the most critical nutrient substance in the maintenance of aquatic productivity. They are essential for the growth of organisms and a nutrient that limits the primary productivity of the water body. In the present study the phosphate content was ranged between 0.05- 0.12 ppm. It was minimum during winter months and maximum during the summer months. Low phosphate contents during winter months and high during summer or post monsoon months may be due to low decomposition of organic matters during summer seasons (Prakash, 2001b)

  Natural waterbodies *viz.*, lakes, wetlands and taals receive their nitrates and phosphate supply from agricultural runoff, sewage effluents and decomposed organic matters. When algae and other micro-organisms die and settle to the bottom of any water body, they carry their cellular nitrogen and phosphorus with them. During decomposition, these nutrients are released and become available for subsequent growth of aquatic flora. Presence of more nitrates and phosphates in summer ad post monsoon months in this taal might be due to released of more nutrients in water after decomposition of organic matter plus entering of new nutrients in taal from vast agricultural run-off. Comparatively lower values during subsequent months result from their active use in the production of post monsoon algal blooms, luxuriant growth of macrophytes and or their dilution in the accumulated rain water. In relation to nutrients status, the lake falls into medium to high productive group (Banerjea, 1967).

- Biological Properties of Taal water (Table2): In the present study, twenty three species of phytoplankton were found. Of these 8 belong to Chlorophyceae (*Pediastrum, , Coelastrum, Scenedesmus, Botryococus, Colosterum , Crucigenia, Ulothrix* and *Chlorella*);7 to Bacillariophyceae (*Synedra, Navicula, Cymbella, Melosira, Cyclotella, Pinnularia* and *Asterionella*); 6 to Cyanophyceae (*Anabaena, Spirulina, Raphidiopsis, Merismopedia, Cloecapsa,* and *Oscillatoria*) and 2 to Euglenophyceae (*Euglena* and *Phacus*). Apart from this 20 species, species of zooplankton were found. Of these 7 species belong to Rotifers (*Asplanchna, Brachinous, Keratella, Notomate, Notholca, Polyarthra* and *Lecane*); 8 to Cladocerans (*Diaphnosoma, Daphnia, Simocephalus, Chydorus, Bosmina, Bosminopsis, Sida* and *Macrothrix*), 3 to Copepods (*Cyclops, Diaptomus*, and *Nauplius* larva) and 2 Ciliates (*Paramecium* and *Vorticella*). Most of these species were present in fresh waterbodies of eastern Uttar Pradesh (Prakash, 2001a, Prakash *et al*., 2002 and Sinha *et al*., 2002). Presence of 23species of phytoplankton and 20 species of zooplankton shows that the taal is rich in planktonic diversity.

Table2. Monthly fluctuations in Plankton Population in Baghel Taal (July, 2018 to June, 2019)

Month	Phytoplankton Group density (Units / Litre)					Zooplankton Group density (Units / Litre)				
	Chloro-phyceae	Cyaono-phyceae	Bacillariophyceae	Euglenophyceae	Total	Rotifera	Cladocera	Copepods	Ciliates	Total
Jul.	384	452	376	45	1257	534	399	164	134	1231
Aug.	398	523	398	51	1370	617	317	214	98	1246
Sep.	374	482	421	76	1353	549	443	211	105	1308
Oct.	421	456	543	62	1482	429	287	313	167	1196
Nov.	423	443	514	57	1437	389	451	356	143	1339
Dec.	587	572	543	53	1755	850	643	654	295	2442
Jan.	350	369	254	32	1005	269	446	465	184	1364
Feb.	296	389	242	24	951	312	445	216	175	1148
Mar.	322	534	245	38	1139	432	392	303	186	1313
Apr.	276	643	275	64	1258	534	434	365	204	1537
May.	297	654	263	79	1293	554	487	403	245	1689
Jun.	1067	1512	987	187	3753	1676	1479	1328	956	5439
Total	5195	7089	5061	768	18113	7145	6223	4992	2892	21252
Average	433	591	422	64	1509	595	519	416	241	1771
%age	28.68	39.13	27.94	4.24	-	33.62	29.28	23.49	13.61	-

The annual periodicity of phytoplankton shows that Cyanophyceae dominated and constituted 39.13% of the total phytoplankton followed by Chlorophyceae (28.68%), Bacillariophyceae (27.94%) and Euglenophyceae (4.24%). In the present study the maximum density of phytoplankton was recorded in June (3753 unit / litre) and minimum in the month of Feb (951 unit / Litre). The annual productivity of zooplankton shows that Rotifers dominated and constituted 33.62% of the total zooplankton followed by Cladocerans (29.28%), Copepods (23.49%) and Ciliates (13.61%). In the present study the maximum density of zooplankton was recorded in June (5439 unit / litre) and minimum in Feb (1148 unit / litre). Similar observation were made by Ansari and Prakash (2000), Prakash (2001a) and Sinha *et al* (2002). The plankton density in the Baghel taal shows is highly productive.

In the present study bimodal pattern of seasonal variation of plankton was found, with a primary peak in the month of June and secondary peak in December (Table2). Similar pattern of plankton distribution were reported in the fresh waterbodies of U.P. by Khan and Siddiqui (1974), Ansari and Prakash (2000) and Prakash (2001a).

In spite of fevourable limnological condition of water, potential fish yield is not being realised. Fish production can be augmented to a great extent if we managed scientifically. It can be realised optimumly by stocking of fast growing Indian major carps, catla, rohu, mrigal and calbasu in ratio 4:3:3 or by stocking of Indian major carp and exotic carp in ratio 3:3:2:2 for catla, rohu, mrigal and common carp, respectively @ 1000-1500 fingerlings/ha to utilize the rich plankton resources.

CONCLUSION

Thus it can be concluded that the taal is slightly below the level of eutrophication as such proper management efforts need to be taken. Efforts like awareness programme among general mass to remove casual attitude of people about water quality deterioration and eutrophication; checking sewage entry, leaching of nutrients and plankton etc. may improve the situation.

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