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Physico – Chemical Analysis of Makhana Pond Water of North Bihar

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ABSTRACT

The fresh water ecosystem consists of physico-chemical nature of the water in terms of the physical factors, viz., temperature, transparency, pH, dissolved oxygen, free carbon dioxide, total alkalinity, hardness, calcium, magnesium, chloride, phosphate, nitrogen and organic matter were examined of Makhana pond in Darbhanga district. The study was made during each of the twelve month of both the years(and) and an average value of each month was computed for every parameter. Low transparency was recorded in summer and high in winter due to high and low temperature and rate of decomposition, respectively. Growth of Euryleferox (Makhana) decreased pH level because of increase of water temperature and dissolved CO_2 pressure and decrease in dissolved oxygen content. Otherwise pH of soil was found around neutrally to slight alkaline due to submergence. Makhana leaves were spread over the water surface, so sunlight penetration was low and also exchange of ambient air was negatively influenced, hence dissolved oxygen value could not reach up to the mark. Value of hardness of water also increases in summer months, due to the accumulation of larged quantities of bicarbonate on account of the excess of free CO_2 produced by the decomposition of bottom deposits. Chloride content of water increased during summer months due to decomposition of organic matter. High concentration of phosphate and nitrate during summer months was noticed due to low decomposition rate. The fluctuation in C/N ratio was dependent on biotic activities of Makhana pond.

Key Words: C/N ratio, Euryle ferox, Fresh water eco sysyem, Limnology, Physico-Chemical factors,

INTRODUCTION

The physico-chemical analyses of water sample, collected either from sea, river, lakes, ponds, springs, even drains or flood is normally studied with reference to temperature, transparency, pH, dissolved oxygen, free carbon dioxide, total alkalinity, hardness, calcium, magnesium, chloride, phosphate, nitrogen and organic matter. However, the proximity as well as the importance of research work has restricted to select a pond of Darbhanga district where makhana was prevailing at rampant rate for industrial consideration.

Makhana pond of Wajitpur in Darbhanga district (Bihar) was selected for the proposed studies. This is a rectangular, shallow and a permanent pond, having concave basin, not exposed to the threat of contamination through the toxic wastes of any industries. However the pond sometimes got polluted by children for swimming. These interferences increase the trophic level of the pond inviting undesirable, luxurious growth of microbes. Although this pond is of high recreational value, good source of animal protein through fish culture but no proper, attempt has been paid for its conservation that led the poor quality assessment of physico-chemical parameters. This has attracted the author to study the physico-chemical analyses of water with reference to fifteen parameters viz, temperature, transparency, conductivity. pH total dissolve solid, carbonate alkalinity, bicarbonate alkalinity, dissolve o_2, free co_2 chloride, calcium, total hardness, calcium hardness, magnesium and organic matter. The physico-chemical study along with other attributes of inland water comes under Limnology [18,19,37].

It is believed that productivity is the result of interaction between multiple physico-chemical (abiotic) and biological (biotic) factors. Studies on the productivity of different parts of Bihar [4,24,30,33] but there appears to be no recorded account of primary productivity of the pond under study and therefore the present study was taken up.

MATERIAL AND METHODS

The Makhana Pond under study is a perennial one and situated in the western side of Darbhanga town (latitude 26^0 10'N and longitude 85^0 54'E) in the Mohalla Wajitpur. It covers an area of about 0.48 hectare. Water spread area was maximum (0.48 ha) during August and minimum (0.37 ha) during May with depth ranging from 0.30 to 1.75 m. integrated fish culture with Makhana (*Euryle ferox*Salisb.) was carried out in this pond for a period from July to August . During this period, water sample was collected 2 meters inside from the bank in plastic cane of 2 liters volume in the second week of every month and between 10- 11 A.M.

Methods Adopted for the Study

The sampling of the experimental pond water was done at monthly intervals on the pond site from July to August for the estimation of physico – chemical characteristics of water. Air and water temperature are recorded by mercury thermometer and pH with the help of pH meter. The transparency was measured by Secchi disc. Other parameters such as dissolved oxygen, free carbon dioxide, total alkalinity, hardness, calcium, magnesium, chloride, phosphate, and nitrogen were determined following Standard Kit Methods. Physico-chemical analysis of the water was made at four sides of the pond. Soil samples were at monthly intervals. The air dried samples were analyzed for pH, organic carbon, nitrogen, phosphorus, potassium [36]. But they did not reveal signification variations in case of any parameter studied presumably because of the frequent mixing of the pond water due to wind velocity and activities of human beings as well as aquatic animals. Therefore, the average value of each parameter, ascertained at the four sides of the pond during July to August was taken into consideration for interpretations. The details of periodical variations in the values of each parameter observed and values of coefficients of correlations (r) among these parameters, may be seen in the Table 1 and 2, respectively.

RESULTS AND DISCUSSION

Living organisms, plants and animals are dependent on the environment of their habitat. They grow and their qualities are developed in a congenial environment. Environment in both terrestrial and aquatic habitats consists of biotic and abiotic components functioning together as "ecosystem". Abiotic part of a fresh water ecosystem consists of physic-chemical nature of the water. In the present study, three physical factors as mentioned above have been taken into consideration. The physic- chemical analyses of the pond water, with reference to the aforesaid parameters have been made during each of the twelve month of both the years of observations and an average value of each month was computed for every parameter. The details of observation may be discussed in relation to the work done by the previous workers as follows:

Temperature:

Air temperature fluctuated from 17^0C (January) to 28^0C (June) and water temperature of open space of pond from 17^0C (January) to 29^0C (June). In the areas covered by the sprawling *E. ferox* leaves during April to August the maximum temperature was recorded during June (29^0C) and the minimum during April (24.6^0C). During the grand growth period (April to June) of Makhana crop, the leaves acted as a blanket barrier between atmosphere and water and hence were responsible for increasing differences between the two temperature. The maximum difference between air temperature and water temperature of the covered areas was 2.6^0C during June' (Table 1). But during harvest period (July and August), this difference decreased. However, the maximum difference between air – and water temperatures of the open space of the pond was recorded duringFebruary (2.0^0C).

Before the sprouting of Makhana leaves on the water surface, air and water were in direct contact, so there was less difference between the two temperatures. But during grand growth period of Makhana crop, water surface was covered with their leaves resulting indirect contact of pond water with incident solar radiation, hence the difference between the two temperatures increased[5,17,36]. Temperature influences the chemical and biological characteristics of water body like chemical reactions, solubility of gases and amplifies the tastes and odours. In present pond the temperature showed significant annual fluctuation [38]. They further concluded that the attainment of high temperature during summer is indicative of shallowness of the pond. It is noteworthy here that in the month of June the temperature was recorded relatively low instead of high as expected, mainly because of the setting of rain on scheduled day of observation.

Transparency:

The transparency of pond water indicates the penetration of light in the waterbody. Secchi disc transparency (cms.) of the studied pond were recorded the maximum being 69 cms (December) and minimum 36.0 cms. in (July). The transparency of the pond water showed significant fluctuation in the different month of the year with annual average mean of 19.850 $\pm$2.8 cm. it showed its higher peak in the month of May (36 cm) and secondary peak in the month of October (26 cm). it is low in the month of

August (9.625 cm) and average during February and July (18.962 -21.25 cm). It was observed that during the phonological cycle of *E. ferox* i.e. from January to August , there was gradual decrease in transparency. But during July – December, gradual decrease in transparency was observed (Table 1).

Transparency shows a direct relationship with the suspended organisms and non – living particles in water [29]. In July , August , July and August , the transparency values were recorded as 36.0 cms, 48.4 cms, 43.0 cms and 42.0 cms respectively which was due to the retention of organic matter in a state of suspension and due to turbulence and increased wave action of water during these monsoon months. [11,39] also reported these factors as cause of low transparency. [5,17] reported low transparency during July – August in a Makhana pond. During May and June high rate of decomposition of organic matter due to high temperature caused tow transparency. This confirms the findings of[31,32]. But during winter months, higher transparency values were recorded due to the slowed rate of decomposition of organic matter due to low temperature. Plankton population also affected the transparency up to some extent.High transparency of water, which refers to the clarity of water, may be attributed to greater amount of sun-shine, better penetration of light, moderate velocity of wind causing stillness of water as well as lesser proportion of dissolved and suspended matters. Minimum value of transparency during rains could be attributed to cloudy weather, poor sunshine and to surface run-off carrying silt and different kinds of organic material. Abrupt fall in the level of transparency in the month of June was recorded due to the sudden rain fall at the time of sample collection.

pH:

The pH of pond water studied during different months varied in between a narrow range of 7.6 to 8.3, the minimum and the maximum values were recorded during June' and December' respectively. It was observed that there was an increasing trend of pH from August' to January and a decreasing trend from February – March (Table - 1)

During the present study, the water of the pond remained neutral to slightly alkaline in nature and this range was considered suitable for Makhana cultivation [5,17]. [15] also observed neutral to alkaline nature of water in Makhana growing pond. [8] recorded such range of pH in macrophyte infested water body.

As the level of hydrogen ion (H^+) increases the solution becomes acidic and its OH^- ionic concentration decreases. pH is in fact the negative logarithm of H^+ ion concentration i.e. $\log_{10} H^+$ or $\log_1/1x10^{-7}$. H ionic concentration is pH or potential of H^+ ion 7, 10^{-6} pH 6 and 10^{-4} as pH 4. It, therefore, means that as compared to neutral pH7, the pH 6 has 10 times more H^+ ions. Similarly pH 8 has 10 times less H^+ ions. A natural water at 25^0C show pH 7, but the same water at 0^0c gives a pH of 7.5 and at 60^0C a pH of 6.5 (A.P.H.A., 1975). The pH of water in nature varies widely due to the mixing of many acidic and basic salts, most commonly it varies between 6-8. pH regulates most of the biological processes and biochemical reactions. Most of the plant and animal species are adopted to live in narrow range of pH and any drastic change in pH adversely affect them. pH and carbon dioxide are even more critical factores in the survival of aquatic plants and fishes than the oxygen supply. As the photosynthesis progresses, the level of O_2 increases and CO_2 decreases. This is also accompanied by some rise in pH. Alterations in pH in natural waters are usually accompanied by changes in other physic- chemical factors also. It is therefore, very essential to monitor the level of pH in a given water body regularly in view of its implications discussed above.

Dissolved oxygen:

Dissolved oxygen content of water varied from 6.04 mg/l (June) to 8.10 mg/l (February). Covered areas showed low dissolved oxygen concentration as compared to open areas and the maximum difference in D.O. content between the two conditions were recorded during June' (0.54 mg/l) whereas, minimum difference in May' (0.10 mg/l). the D. O. values showed gradual increase from July' to February' except in January' when its content decreased to 7.80 mg/l (Table-1).

Oxygen is available in dissolved form in water. The main source of dissolved oxygen in any water body is from the atmosphere and photosynthesis activities of the aquatic green plants. The amount of oxygen in water depends on the surface area exposed, temperature and salinity. Dissolved oxygen is an important factor for assessing water quality. Water, where organic pollution is very high have very little oxygen dissolved in them. Self purification of a water system depends on the presence of sufficient amount of oxygen dissolved in it. When oxygen is used up faster than it is replace, the water quality begins to deteriorate.

Gradual decrease in the dissolved oxygen content from March (6.04 mg/l) to June (5.25 mg/l in open areas and 5.35 mg/l in covered areas) was due to the covering of sprawling leaves of Makhana crop over the water surface to decrease the photosynthetic rate of submerged macrophytes and increased consumption of oxygen for decomposition of organic matter and enhanced rate of respiration by aquatic fauna. Lowering of the D. O. value due to aquatic macrophytes [7,35,9,14]. Reduction in the D. O. content

due to decomposition of organic matter [32]. Winter season (October to March) witnessed higher values of the dissolved oxygen due to high solubility of atmospheric oxygen at lower temperature[22]. Again at low temperatures, there was less decomposition of organic matter, so the consumption of oxygen during this process was low on the other side during winter season high rate of photosynthesis of submerged macrophytes and phytoplankton enhanced the D. O. content of water. [26,13].

Free Carbon Dioxide:

The concentration of free CO_2 was recorded (Table - 1) to be minimum in March (26.0 mg/l) and maximum in June (32.4 mg/l in open area and 34.0 mg/l in covered area). During the grand growth period of Makhana crop (April to June), there was an increasing trend in free carbon dioxide value in the covered areas but the value decreased during the harvesting period (July and August). Free carbon dioxide content showed maximum difference between open and covered areas in June (2.4 mg/l).

The maximum value of free CO_2 during the summer months was due to the decomposition of algae, submerged macrophytes and the bottom organic nutrients.[22,29] Observed high content of free CO_2 values during summer. [16]Concentration of free CO_2 is directly correlated with the amount and nature of biological activities in water. Decomposition of macrophytes increases the free CO_2 content of water [12,3]. Covered areas of the pond showed high free CO_2 due to sprawling leaves which acted as a blanket barrier on the water surface. [7]Observed similar influence in water hyacinth infested water bodies. [14] observed increase of CO_2 content due to abundance of vegetation. Lower values of free CO_2 during winter season was due to high photosynthetic activities utilizing CO_2 by the submerged macrophytes and the algae which coincides with the findings of [22]. Again at low temperature, the rate of decomposition of organic matter was slow to release less free CO_2 in water.

Toal Alkalinity:

The total alkalinity (T. A.) of water varied in between 90.0 mg/l to 124 mg/l, the former represented the value for the month of March and the later for the month of June in the covered areas. A successive decrease in the content was recovered from January to March during the seedling stage of Makhana crop. But after the onset of grand growth stage, the total alkalinity content started to increase from 115.0 mg/l in open areas and 118.0 mg/l in covered areas during April' to 124.0 mg/l in open areas and 125.0 mg/l in covered during June' . During the harvest stage (June and August) there was a trend of decrease in its content. It was observed that during the period from July to December , there was successive decrease in the content of total alkalinity from 120.0 mg/l to 85.0 mg/l except in the month of October' when it reached upto 125.0 mg/l (Table - 1).

The alkalinity is an important measure to determine the quality of water. It indicates the productivity of water body. [25]Classified the water bodies on the basis of alkalinity into low (40-50 ppm), moderately high (50-100 ppm) and high (100-200 ppm) in productivity, according to which the present experimental pond was a nutrient rich aquatic body. Maximum and minimum alkalinity was recorded during June and March respectively which confirms the findings of [17]. Rise in total alkalinity during summer months was due to low utilization of free CO_2 for photosynthesis by the submerged macrophytes which were less dense during the summer months and major portion of free CO_2 was most probably converted into carbonic acid. The Carbonic acid formed acted over the insoluble forms of the carbonates of Ca and Mg to convert them into soluble form of their bicarbonates.

Hardness

The total hardness varied from 112.0 mg/l to 205.0 mg/l. its lower amount was recorded in March' whereas, in June' the highest value was observed as 195.0 mg/l in the covered areas and 190.0 mg/l in open areas. During the seedling stage of Makhana crop (January to March) there was a decrease in its content from 122.0 mg/l in January to 112.0 mg/l in March . But during the grand growth stage (April to June) there was a gradual increase from 152.0 mg/l in April to 190.0 mg/l (open areas) and 195.0 mg/l (covered areas) in June . The harvest stage witnessed gradual decrease in its content (Table - 1).

The value of Hardness of water is influenced by the free CO_2 dissolved in it. During summer months hardness value increased due to accumulation of large quantity of bicarbonates on account of the presence of excess of free CO_2 produced by the decomposition of bottom deposits which probably resulted in the conversion of insoluble carbonate into soluble bicarbonates. Singh (1990) also recorded similar relationship.

Calcium and Magnesium:

The maximum value of Ca was observed during June (40.05 mg/l in open areas and 42.55 mg/l in the covered areas) whereas, the minimum was found during March (2.1 mg/l). During the seedling phase of the Makhana crop, the Ca content were 24.12 mg/l, 30.20 mg/l and 20.85mg/l in January, February and March respectively. But during grand growth stage (April to June) there was gradual increase in its content whereas, during the harvesting period, Ca content decreased. During July20; to December , no regular trend was recorded.

The higher concentration of Mg was recorded in February (15.85 mg/l) whereas, lower concentration in August (7.05 mg/l) in open areas and 6.05 mg/l in covered areas). Mg content showed the same trend like that of Ca content.

Water having less than 10 ppm Ca^{+2} is considered as poor, with 10 to 25 ppm Ca^{+2} as medium and with more than 25 ppm Ca^{+2} as rich. On this basis the experimental pond is rich in Ca content.[3] observed that the ponds with macrophytes contain high Ca content. Increased of Ca content during the grand growth period and decrease during harvest phase confirm the findings [5]. The higher concentration of Ca during summer was reported by [24] also. The gradual rise in the Ca content during summer might be due to rapid oxidation of organic matter in the substrate [32]. Decline in its content during winter months might be due to its utilization by the submerged macrophytes and phytoplankton.Magnesium content was maximum in February and minimum in August.

Chloride:

The chloride content of water varied in between 55.20 mg/l to 82.2 mg/l, the former represented the value for the month of March' and the later for July in covered areas. During the seedling phase, there was decrease in its content. But from April to June , there was an increase in its content in the open areas. The trend was observed uptoJuly in the covered areas. There was regular decrease in the content of chloride from July' to October. But in November its concentration increased drastically and continued up to January (Table - 1)

The present experimental pond showed high chloride content during the grand growth period (April to June).[34,32]There was an increase in chloride content during summer. Increase in chloride content during summer months might be due to decomposition of organic matter. This supports the findings of [23,24]. The pond studied had high chloride content due to the presence of Makhana plants and other macrophytes. [3]Observed high chloride content in the ponds infested with macrophytes.

Phosphate:

Phosphate content varied from 0.225 mg/l (February') to 1.220 mg/l (July and June). During the seedling period of the crop, its contents were 0.250 mg/l, 0.230 mg/l and 0.930 mg/l in january, February and March respectively. During the grand growth stage (April to June), there was gradual increase in its content in both open and covered areas. The concentration of phosphate was recorded as0.932 mg/l, 1.215 mg/l and 1.220 mg/l in April, May and June respectively in open areas whereas, 0.930 mg/l, 1.210 mg/l and 1.212 mg/l in April, May and June respectively in covered areas. There was successive decrease in phosphate content during harvest period (July and August). It decreased from 1.210 mg/l to 1.200 mg/l in covered areas. The regular decrease in phosphate content was observed from July (1.220 mg/l) to December (0.885 mg/l). (Table - 1)

The high phosphate content was observed in the macrophytes infested ponds [3]). But [8,21] observed low content in weed infested wetlands. Grand growth period showed a trend of increase in its content and decreasing trend during harvest period correspond with the finding of [6]. High phosphate concentration during summer season may be attributed to high bacterial decomposition of organic matter at high temperature. This supports the findings of [23,33]. Low concentration during winter may be due to low bacterial activity at decreased temperature and high consumption of nutrients during photosynthesis of macrophytes and phytoplankton. [24] also made similar findings. But [8] recorded high phosphate during post monsoon months and low values in pre – monsoon periods.

Nitrogen:

The nitrogen content of water varied in between 0.960 mg/l and 0.150 mg/l, the former value was observed during February' and latter in July' . There was decrease in nitrogen concentration from 1.540 mg/l (July') to 0.960 mg/l (February') but during March' its value increased to 1.250 mg/l and such trend was recorded upto June' (1.520 mg/l in open areas and 1.518 mg/l in covered areas). During July' , the nitrogen concentration was 1.395 mg/l in open areas and covered areas whereas, in August' , the values were 1.391 mg/l and 1.395 mg/l for open and covered areas respectively. (Table -1)

According to [3] macrophyte infested ponds contain high nitrate concentration. [8] observed low content in weed infested wetlands. Its content varied in between 0.960 mg/l and 1.540 mg/l. During the summer season, nitrate content was high due to the decomposition of organic matter at high temperature. [24,32] also reported such effects. But they observed minimum concentration during May. The pond studied had low nitrate content during winter season which may be due to sedimentation, less decomposition of organic matter and biogenic uptake by the phytoplankton and macrophtes. This is in conformity with the findings of[1,23] reported lowest value of nitrate during winter and the highest during summer.

Pond Soil;

The pH of pond soil varied in between 7.1 to 7.7 (Table -2) it remained constant for four times during July, August, November and February at 7.7; in September . March , July and August at 7.3; in December and January at 7.5 and during April and May at 7.2. The value of pH was the highest (7.9) during December

and January . It started decreasing from February and this trend continued till the completion of grand growth phase i.e. till June . But during harvest phase its value increased.

There was decrease in the percentage of organic carbon from seedling phase to grand growth phase, the value successively ranged from 0.610% to 1.105%. It remained constant at 1.0% during August and September at 0.840% during October and December and 0.610% during May and June . During the harvesting period, the percentage of organic carbon was recorded 0.900% and 1.105% in July and August respectively. There was step wise decrease in its percentage from September (0.0%) to June(0.610%) except during December when there was slight increase in its content (0.840%). (Table - 2)

C/N ratio during the present study fluctuated in between 8.933 to 13.456 but [6] recorded nearly 9 to 10 throughout the year in the same biotopeand reported that C/N ratio varied in between 7.44 to 15.13. [28] reported 10.46 to 10.60 in a fish pond. C/N ratio controls the bacterial activity in the pond soil [10]. According to him, the bacterial activity is low when the ratio falls below 10 and high when the ratio is 20 or higher on this basis, the rate of the bacterial activity of the present pond can be considered as medium.[27] correlated fish productivity with C/N ratio and grouped fish ponds under four ranges, viz < 5, 5 to 10, 10 to 15 and > 15 and noted that C/N ratio < 5 is indicative of poor production, 5 to 10 for better production, 10 to 15 represents the ideal condition and above 15 appears to be less favorable. On this basis, the present pond is at productive level. Lower C/N ratio appeared to be more congenial for aquatic productivity than the wide ration [20].

TABLE – 1. MONTHLY VARIATIONS OF PHYSICO – CHEMICAL PROPERTIES OF POND WATER

PARAMETERS		Atmospheric Temp. (0^0C)	Water Temp. (0^0C)	Transparency (Cm)	pH	DO (Mg/L)	Free CO_2 (Mg/L)
AUG	COVERED AREAS	-	27.0	-	7.5	6.52	31.1
	OPEN AREAS	27.2	27.0	42.0	7.5	6.	30.9
JULY	COVERED AREAS	-	27.0	-	7.4	6.45	30.9
	OPEN AREAS	28.9	28.6	43.0	7.5	6.88	30.3
JUNE	COVERED AREAS	-	28.0	-	7.6	5.35	34.0
	OPEN AREAS	32.0	30.0	57.0	7.4	5.25	32.4
MAY	COVERED AREAS	-	27.0	-	7.4	6.02	30.4
	OPEN AREAS	28.5	28.0	58.0	7.5	6.12	30.2
APRIL	COVERED AREAS	-	24.6	-	7.6	6.68	29.2
	OPEN AREAS	25.3	25.0	70.0	7.6	6.92	29.1
MAR		22.5	22.0	69.0	8.0	6.85	26.0
FEB		21.0	19.0	67.0	8.0	8.0	26.1
JAN		17.0	17.0	70.0	8.1	7.80	27.0
DEC		18.5	18.2	69.0	8.0	8.05	26.4
NOV		21.2	20.0	60.0	8.0	7.64	27.0
OCT		24.3	22.0	65.0	7.9	7.52	28.4
SEPT		26.5	26.0	50.0	7.7	7.48	28.0
AUG		27.6	28.2	48.0	7.7	7.10	28.2
JULY		26.5	28.2	34.0	7.9	7.10	29.1

Total Alkalinity (Mg/L)	Hardness (Mg/L)	Ca (Mg/L)	Mg (Mg/L)	Chloride (Mg/L)	P (Mg/L)	Total N (Mg/L)
105.0	179.0	35.25	12.52	70.0	0.125	1.525
104.0	155.0	40.05	10.62	67.68	1.215	1.335
115.0	122.0	40.	9.45	61.70	1.220	1.198
125.0	128.0	33.06	9.50	59.50	0.930	1.160
92.0	113.0	27.05	6.45	61.15	0.920	1.105
90	115.0	27.010	7.81	63.20	0.885	0.990
100.0	122.0	25.42	10.61	61.52	0.250	0.972
82.0	112.0	32.20	15.85	62.22	0.225	0.150
87.0	115.0	20.85	6.12	55.20	0.930	1.250
113.0	152.0	32.65	10.16	62.15	0.932	1.250
115.0	144.0	32.70	11.10	62.10	0.930	1.260
123.0	169.0	40.	12.66	71.0	1.215	1.310
122.0	175.0	40.98	12.02	73.5	1.210	1.220
124.0	188.0	40.05	14.19	76.22	1.220	1.520
123.0	205.0	42.55	14.20	79.0	1.212	1.518
111.0	175.0	39.63	14.66	78.0	1.210	1.488
115.0	182.0	40.10	13.91	82.23	1.2	1.441
110.0	192.0	33.06	7.05	75.0	1.200	1.395
1.0	184.0	33.04	6.05	75.2	1.200	1.391

TABLE – 2. CHEMICAL PROPERTIES OF THE POND SOIL

PARAMETERS	pH	C (%)	N (%)	P (mg/100gm)	K (mg/100gm)	C/N RATIO
JULY	7.7	1.025	0.5	12.70	145.40	10.842
AUG	7.7	1.120	0.075	12.90	148.30	13.525
SEPT	7.3	1.105	0.3	13.62	155.10	13.132
OCT	7.4	0.832	0.0	15.25	140.23	10.993
NOV	7.7	0.832	0.2	11.93	135.32	9.005
DEC	7.9	0.775	0.5	10.20	129.43	9.130
JAN	7.5	0.804	0.0	9.81	115.20	9.130
FEB	7.7	0.775	0.063	9.61	118.4	12.539
MARCH	7.3	0.718	0.055	10.10	116.31	12.763
APRIL	7.2	0.630	0.052	7.83	110.10	13.855
MAY	7.1	0.725	0.050	7.21	106.0	12.200
JUNE	7.1	0.610	0.050	7.18	105.0	12.200
JULY	7.3	0.900	0.070	10.90	106.0	12.857
AUG	7.3	1.125	0.5	11.50	130.0	11.510

CONCLUSION

There is a direct relationship of transparency with the suspended organism and suspended particulate matter in the water. In summer especially in May and June, due to high temperature and high rate of decomposition, cause low transparency, whereas during winter season because of low temperature the rate of decomposition of organic matter is slow hence the transparency is recorded higher.

During the grand growth of *E. ferox* (Makhana) decrease in pH level has been seen because of increase of water temperature and dissolved CO_2 pressure and decrease in dissolved oxygen content. Otherwise pH of soil around neutrally to slight alkaline due to submergence. There is a positive impact of neutral to slight alkaline pH has been found. Makhana leaves were spread over the water surface, so sunlight penetration was low and also exchange of ambient air was also negatively influenced hence dissolved oxygen value could not reach up to the mark. Dissolved oxygen value was maintained balanced because of the left vacant space in experimental pond.

In summer months there is a rise in total alkalinity was due to less utilization of free CO_2 for photosynthesis by the submerged macrophytes which was having less vegetation during that season. Value of hardness of water also increases in summer months, due to the accumulation of larged quantities of bicarbonate on account of the excess of free CO_2 produced by the decomposition of bottom deposits. Chloride content of water increased during summer months due to decomposition of organic matter. High rate of bacterial decomposition results into high concentration of phosphate and nitrate during summer months. While in winter the value lowers due to low decomposition rate.

REFERENCES

1. A.P.H.A. (1975). Standard Methods for the Examination of water and Waste waters (14th edition), American Public Health Association, New York.
2. Ajmal, M. and Razi–ud–din. 1988. Studies on the pollution of Hindon River and Kalinadi (India). In Ecology and pollution of Indian River (R.K. Trivedi Ed.). Asian Publishing House, New Delhi: 87 – 111.
3. Alam, A., Khan, A. A., Gaur, R. K. Alam, M. A. 1995. Physico – chemistry of four lentic fresh water bodies infested by varying dominant biota with emphasis on the impact and couses of proliferation of dominant biota. J. Freshwater Biol. 7 (2): 99 – 104.
4. Bilgrami, K.S. Munsi, J.S. Dutta, Siddiqui, F.N. and Singh, N.K. (1979). Primary productivity of phytoplankton of the river Ganga, Biol. Bull. India. 1: 39-42.
5. Dudani, V. K., Kumar S., Pandey, A. K., Sidiqui, E. N. Gastropod macrophyte association in some of Darbhanga. Environ. Ecol. 5 (1): 100 – 104.
6. Dutta, R. N. (1984). Comarative ecological study of Euryale ferox Salisb. (Makhana) in Darbhanga area, Ph. D Thesis, Ranchi Univ.
7. Gopal, B. Trivedi, R. K. and Goel, P. K. 1984. Influence of water hyacinth cover on physic – chemical characteristics of water and phytoplankton composition in a reservoir near Jaipur (India). Int. Review Hydrobiol. 69 (6):359 – 865.
8. Gorai, B. K., Panday, P. N. and Jha, B. C. 1999. Abundance and fluctuation of plankton population in relation to certain physic – chemical properties in a Wetland, North Bihar. Abstract in National Seminar on Eco – friendly management of resources for doubling fish production strategies for 21st century Inland Fish. Soc. India & Cent Inland Fish. Soc. India & Cent. Inland Fish. Res. Inst. Barackpore. 22 & 23rd Dec. 1999, p. 79.
9. Jamil, K. 1993. The role of macrophytes in aquatic ecosystem. J. Freshwater Biol. 5(2):141-145.
10. Jhingran, V. G. 1985. Fish and fisheries of India. Hindustan Publishing Corporation, Delhi.
11. Kaul, A. 1983. The hydrobiology of Hoksar, Kasmir. M. Phil. Dissertation, Kashmir University.
12. Khan, A. A., Siddiqui, A. Ali, M. Hameed, T. 1978. Physico – chemical and biological characteristics of a pond chautal. J. Zool. Res. 2(1):1-13.
13. Khan, I. A. and Khan, A. A. 1985. Physico – chemical conditions in SeikhaJheel at Aligarh. Environ. And Ecol. 3(2):269 – 274.
14. Kumar, D. 1997. Role of macrophytes diversity in degradation of pond ecosystems. J. Inland Fish. Soc. 29(1): 43 – 53.
15. Mahto, A. 1992. Comparative limnological studies on eutrophicated and non eutrophicated ponds of Makhana (Euryale ferox Salisb.), In Darbhanga (North Bihar), Ph. D. Thesis, L. N. Mithila University, Darbhanga.
16. Michael,R. G.1969. Seasonal trends in pysico – chemical factors and plankton of fresh water fish pond and their role in fish sultureHydrobiol. 33:144-160.
17. Mishra, R. K., Jha, V., Mahto, A. and Kumar, R. 1996. Bio – ecology, cultivation and storage ecology of Makhana (Euryale ferox Salisb.) in North Bihar, India. In Environment and Biodiversity, Jha, et. al. (eds.), Ecological Society, Kathmandu, Nepal, p. 120 -127.
18. Nandan, S.N. and Patel, R.J. (1999). Study of algae communities in river vishwamitri, Baroda as indicators of organic pollution, **Indian.j. Ecol. 22**: 11-15.
19. Nandan, S.N. and Patel, R. J. (2004). Ecological studies on blue-green algae of polluted habitats of Gujarat state fertilizer company Baroda, proc, v. Indian. Geophytol cont. Lukhnow (2003) spl. Publ, 226-231
20. Nath, D. 2001. Water and Soil characteristics of the Narmada estuary before commissioning of sardar sarobar dam. J. Inland Fish. Soc. India. 33(2): 37-41.

21. Palui, D., Srivastava, V. K. and Jha, B. C. 1999. Limno – chemical features of Bishanupur Ox – blow lake, Gandak Basin. North Bihar. Abstract in National Seminar on Eco – friendly management of resources for doubling fish production strategies for 21st century. Inland Fish. Soc. India. Cent. Inland. Fish. Res. Inst. Barrackpore. 22 & 23 Dec. 1999. P. 57.
22. Panday, K. K. and Lal, M. S. 1995. Limnological studies of garhwal Himalayan Hill Stream Khanda gad: Seasonal fluctuation in abiotic profile. J. Freshwater Biol. 7(1):7-11.
23. Panday, R. S. and Verma, P. K. 1992. Limnological status of an ancient temple pond Shivaganga of Deoghar, India. J. Freshwater Biol. 4(3):163-174.
24. Patralekh, L. N. 1994. Comparative account of physic – chemical properties of three freshwater ecosystems. J. freshwater Biol. 6(2):115-119.
25. Phililpose,M. T. 1960. Freshwater phytoplankton of inland fisheries. Proc. Symp. Algology. 4:275-291.
26. Qadri, M. Y. and Shah, G. M. 1984. Hydrobiological features of Hokarsar, a typical wetland of Kashmir. I. Biotope. India J. Ecol. 11(2):203-206.
27. Rai,D. N. and Dutta Munshi, J. S. 1979. The influence of thick floating vegetation (water hyacinth, Eichhornia crassipes) on the physic – chemical environment of a freshwater wetland Hydrobiol. 62:65-69.
28. Rai, S. P. 1994. Impact of sewage effluents on soil variables of some non drainable fish ponds. J. Inland Fish. Soc. 26(1):83-88.
29. Rawat, M. S., Juyal, C. P. and Sharma, R. C. 1995. Morphometry and Physico – chemical profile of high attitude Lake Deoria Tal of Garhwal Himalaya. J. Freshwater Biol. 7(1):1-6.
30. Saha, L.C. & Pandit, B.(1990). Dynamics of primary productivity between lentic and lotic system in relation to abiotic factors**;** J Ind Bot Soc. 69.(III & IV):213-217**.**
31. Sharma, K. P., Goel, R. K. and B. Gopal. 1978. Limnological studies of polluted freshwater 1. Physic –chemical characteristics. Int. J. Ecol. Environ. Sci. 41:89-105.
32. Singh, M. 1995. Impact of human activities on the physico – chemical conditions of two fish ponds at Patna (Bihar), India, J. Freshwater Biol. 7(1):13-17.
33. Singh, R.(1990). Correlation between certain physico-chemical parameters and primary production of phytoplankton at jamalpur, munger, india. **Geores** (jodhpur) 17(5,6): 229-234.
34. Swarup, K. and Singh, S. R. 1979. Limnological studies on Suraha Lake (Belha) J. Inland Fish. Soc. India. 11(1):22-2
35. Trivedi, R. K. and Ghadge, M. R. 1987. Impact of water hyacinth on physic – chemical characteristics and phytoplankton of two reservoirs Mendel. 4(4):217-221.
36. Trivedi, R. K. and Goel, P. K. 1986. Chemical and Biological methods for water pollution studies Environmental publ. Karad, India. 251. P.
37. Venu, P. & Kumar, V., Sardana, R. K. and Bhasin, M.K.(1984). Indicatory and functional role of phytoplankton in effluents of rangpodistillaries of Sikkim Himalayas. **Phykos.**23 (1,2):38-44.
38. Vyas L.N and kumar, H.D. (1968). Studies on the phytoplankton and other algae of indrasagar tank Udaipur. India. **Hydrobiogia**31: 421-434.
39. Zafar,A. R. 1967. On the ecology of algae in certain fish ponds of Hyderabad. III. Periodicity – Hydrobiol. 30:6-112.

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