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ASSESSING THE HYDROBIOLOGICAL PARAMETERS OF GAYA JI DAM IN GAYA,BIHAR, INDIA.

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ABSTRACT

Water is one of the most essential natural resource of our planet which is required for survival and sustenance of biota.The ecological status of water body measures the overall health of its aquatic ecosystem. The present investigation deals with month and season wise variation on various hydrobiological parameters of Gaya Ji dam. Water temperature (27.0°C), FCO2 (15.17 mg/L), BA (207.25 mg /L), Chloride content (113.25 mg /L), Sulphate (39.92 mg /L), TH (120.5 mg /L), TN (0.59 mg /L) and BOD (5.85 mg /L) were recorded maximum during summer. pH (7.67), Transparency (43.65 cm), D.O (7.85 mg /L), CA (12.55 mg/L) and GPP (1.88 mg C/L/hr) were reported maximum during winter season where as Silicate (28.42 mg/L) and Phosphate (0.61 mg /L) showed maxima during monsoon.The nature of water was alkaline through out the year and showed bicarbonate type of alkalinity.The study of various hydrobiological parameters and their statistics reveals that the water was nutrient rich and productive which support directly and indirectly the growth of phytoplankton, zooplankton and ichthyofauna.

KEYWORDS: Hydrobiological; Gaya; Biota; Alkaline.

INTRODUCTION

Water is one of the most essential natural resources on our planet that account about 71% of the total earth surface which is required for survival and sustenance for all living organisms. It acts as solvent and serve as a medium for all the metabolic activities of biota. In nature the water plays an important role in hydrological cycle through evaporation, condensation and precipitation in the form of rain or snow.

The anthropogenic activities are increased many folds through various means such as population explosion, urbanization, industrialization and by agro farming that causes contamination of water bodies (Simpi et.al.; 2011).

The ecological health status of water bodies depends upon their physico- chemical properties and abundance of fauna and flora.(Sharma et.al.; 2009).

The water Framework directive (WFD) advocated the stipulated criteria of phyico –chemical and biological parameters to assess the ecological health of the water body (Almeidi; 2020). The phytoplankton and zooplankton are the basic bio indicators to assess the quality of water (Manickam et.al.; 2017).

In the present study an attempt have been made to assess the quality of various hydrobiological parameters of Gaya Ji dam and to know the health status existing biota in the aquatic habitat.

Study Area

The Gaya Ji dam is located in the vicinity of Gaya city on Falgu river. It is the longest rubber dam in the country spanning 411 meters in the length. Its geographical coordinates 24°46'48'' N and 84°58'54'' E which provides vital water storage for hundreds of thousands of pilgrims.

MATERIALS AND METHODS

The sampling of water were carried out month wise from January 2023- December 2023 for the analysis of various hydrobiological parameters. The water sample was analyzed by following the standard methodology of APHA (1985), Trivedi and Goel (1984).

The pH was measured by pH meter and universal indicator. The temperature was measured by using mercury thermometer graduated up to 110°C.Transparency was determined by Secchi disc method. The Dissolved oxygen (DO) was determined by Winkler's method. The BOD was calculated by incubating the sample at 20 °C for 5 days and measuring the difference in dissolved oxygen.

The free carbon dioxide (FCO2) was determined by using phenolphthalein indicator by following the APHA method. The carbonate and bicarbonate alkalinity were determined by using methyl orange and phenolphthalein indicator by following the methodology of APHA. The sulphate and phosphate were determined by turbidimetric and stannous chloride method respectively. The total hardness was estimated by EDTA titrimetric method. The chloride was determined by Argentometric titration method. Silicate was determined by following the method of Mishra and Yadav (1978). The total nitrogen was estimated by Micro Kjeldhal method. GPP was determined by using light and dark bottle method. The collected month wise data was finally pooled into season wise.

Statistical analysis

Mean $(\bar{X})$, Standard deviation (SD), Correlation coefficient (r), Standard error (SE) were analyzed through which t value and 5 % level significance were calculated.

RESULTS AND DISCUSSION

The various hydrobiological parameters were quantitatively analyzed and listed in Table 1-4 and Fig. 1 (A)- (C). The variation in water temperature were noticed which showed maxima in summer(27°C) and minima in winter(19.4°C) which are in accord the finding of Jhingran (1975) and Pahwa and Mehrotra (1966).

The water was turbid yellowish –reddish during monsoon which is due to rain fall, turbulance of water and receiving silt from the catchment area. It was clear during winter which was due to Settling of silt and calm water.

The water transparency showed maxima (43.62cm) in winter and minima (28.85 cm) in monsoon. It is due to settling of silica, clay, other suspended particles and lack of turbulance of water in winter where as it was opposite in monsoon. Similar finding was also reported by Kedar et.al.(2008).

The slight variation in pH was reported which was highest in winter (7.67) at low temperature and lowest (7.2) in summer at high temperature that causes more decaying of organic matters and hence low pH. This finding is akin to work of Adebisi (1981) and Tara et.al, (2011). The water was slight alkaline through out the year.

The maximum and minimum dissolved oxygen were noticed 7.85 mg/L and 6.65 mg/L during winter and summer season respectively. An inverse relationship was reported between dissolved oxygen and temperature which is an accord with the finding of Mishra and Yadav (1978).

The free carbon dioxide (FCO2) was recorded highest during summer (15.17 mg/L) which is due to decomposition of organic matters and lowest in monsoon (9.87 mg/L). Narayan et.al.(2007) were also made similar finding.

The carbonate alkalinity showed highest value during January (20.2 mg/L) and in few months it was reported nil.It was recorded maximum in winter (12.55 mg/L) and minimum in monsoon (2,37 mg/L). The bicarbonate alkalinity was recorded minimum (140 mg / L) and maximum (207.25 mg / L) during summer and winter respectively. It is concerned with less and more decomposition of organic matters with respect to temperature which is akin to finding of Michael (1969).

The total hardness (TH) was observed maximum in summer (120.5 mg /L) and minimum (76.5 mg/L in winter which is akin to finding of Kaur and Sharma (2001).The low water content at high temperature due to evaporation that may causes the increased of total hardness.

The chloride content was recorded maxima (113.25 mg /L) and mimima (50.75 mg /L) during summer and monsoon respectively. It is due to less water content during summer and dilution of water during monsoon. Similar observation were also made by Pahwa and Mehrotra (1966) and Ray et.al. (1966).

The sulphate content showed maxima (39.92 mg/L) and minima (26.47 mg /L) in summer and winter respectively. It is due to low water level during summer which is an accord to finding of Agarkar and Garode (2000).

The silicate content was observed maximum (28.42 mg/L) during monsoon which is due to influx of silicate from catchment area and it was minimum (8.82 mg /L) during winter which is due to its utilization by diatoms. Similar finding was also made by Pahwa and Mehrotra (1966).

The nitrogen content showed maxima during summer (0.59 mg/L) and minima during monsoon (0.21 mg/L)

which is concerned with low and high water content respectively.. This is an akin to finding of Verma and Mathur (1971).

The Phosphate content was recorded highest (0.61 mg /L) and lowest (0.44 mg/L) in monsoon and winter respectively. It is due to receiving organic matters from the catchment area via surface run off during monsoon and its utilization during winter by luxriant growth of phytoplankton organisms.

BOD was recorded maximum (5.85 mg /L) during summer due to excessive decomposition by microbial organisms where as it was miminum (3.4 mg /L) during winter which is due to less favourable temperature for decomposition of organic matters. Similar obsdervation was made by Sachidananda Murthy (2006).

Gross primary productivity (GPP) showed maxima (1.88 mg C/L/hr) and minima (1.39 mg C/L/hr) during winter and monsoon respectively. It is due to intense light intensity and luxriant growth of phytoplankton organisms during winter and turbid and less phytoplankton organisms during monsoon.

Correlation (r) between different parameters

In present study the correlation coefficient (r) between each parameter pair were computed by their mean values as listed in the correlation matrix (Table 3). A positive correlationship were obtained between temperature with transparency (r= 0.57488), FCO2 (r = 0.87352), BA (r = 0.42639), Chloride content (r = 0.33036),Silicate (r =0.747064), sulphate (r = 0.906940), TN (r = 0.193587), TH (r = 0.62037), Phosphorous (r = 0.577390) and with BOD (r = 0.653857).

A negative correlationship were observed between water temperature with pH (r = - 0.60114), D.O.(r = - 0.816022), CA (r = -0.50811) and with GPP (r = - 0.89508).

A significant difference were recorded by using paired t-test of pH with water temperature, FCO2, chloride content, silicate, sulphate, TH, transpatency, BA, Phosphorous content,total nitrogen content and with GPP (a = 0.05) and no significant difference were noted with CA and DO (a= 0,05).

Table – 1: Monthly variation in hydrobiological parameters of Gaya Ji dam, 2023.

Parameters/ Months	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
WT°C	17.5	21.1	24.0	26.5	29.1	28.4	26.2	24.4	24.1	25.0	18.0	21.3
WC	C	C	C	PT	PT	PT	T	T	T	C	C	C
TRANSP(cm)	46.2	41.0	40.2	56.5	34.0	32.0	26.1	27.4	29.5	32.4	42.5	45.0
pH	7.2	7.6	7.4	7.2	7.0	7.2	7.2	7.3	7.5	7.8	7.6	7.8
DO2(mg/L)	8.3	7.8	7.3	6.9	6.4	6.0	6.5	6.8	7.0	7.2	7.3	8.0
FCO2(mg/L)	11.1	9.1	13.3	14.1	16.2	17.1	12.3	10.4	9.5	7.3	10.0	10.3
CA(mg/L)	20.2	17.5	-	13.5	15.4	-	-	-	9.5	-	-	12.5
BA(mg/L)	130.0	141.1	193.4	198.5	208.6	228.5	158.6	153.5	150.0	143.6	137.4	151.5
CL(mg/L)	64.0	69.0	110.0	119.0	115.0	109.0	44.0	50.0	52.0	57.0	51.0	58.0
SL(mg/L)	11.3	12.6	14.4	18.0	21.2	22.3	34.5	29.3	26.5	23.4	12.5	11.5
SUL(mg/L)	22.4	25.1	36.2	43.0	41.0	39.5	34.5	27.2	22.6	37.1	28.4	30.5
TH(mg/L)	80.0	69.0	113.0	123.0	128.0	118.0	108.0	105.0	98.0	88.0	83.0	74.0
TN(mg/L)	0.38	0.44	0.50	0.59	0.66	0.62	0.16	0.18	0.24	0.29	0.34	0.36
PHOS(mg/L)	0.40	0.39	0.44	0.49	0.56	0.57	0.64	0.66	0.60	0.54	0.50	0.48
BOD(mg/L)	3.1	3.5	5.0	6.5	6.0	5.9	4.5	4.2	4.0	3.8	3.6	3.4
GPP (mgC/L/hr.)	2.30	1.80	1.70	1.55	1.50	1.45	1.40	1.35	1.33	1.50	1.65	1.85

Table – 2: Seasonal variation in hydrobiological parameters of Gaya Ji dam, 2023.

Season/ Parameters	WT°C	TRANSP	pH	D.O	FCO2	CA	BA	CL	SL	SUL	TH	TN	PHOS	BOD	GPP
Summer	27.0	36.65	7.2	6.65	15.17	7.22	207.25	113.2	18.9	39.9	120.5	0.59	0.52	5.85	1.55
Monsoon	24.9	28.85	7.4	6.87	9.87	2.37	151.4	50.7	28.4	30.3	99.7	0.21	0.61	4.75	1.39
Winter	19.4	43.6	7.6	7.85	10.12	12.5	140.0	60.5	8.82	26.4	76.5	0.38	0.44	3.4	1.88

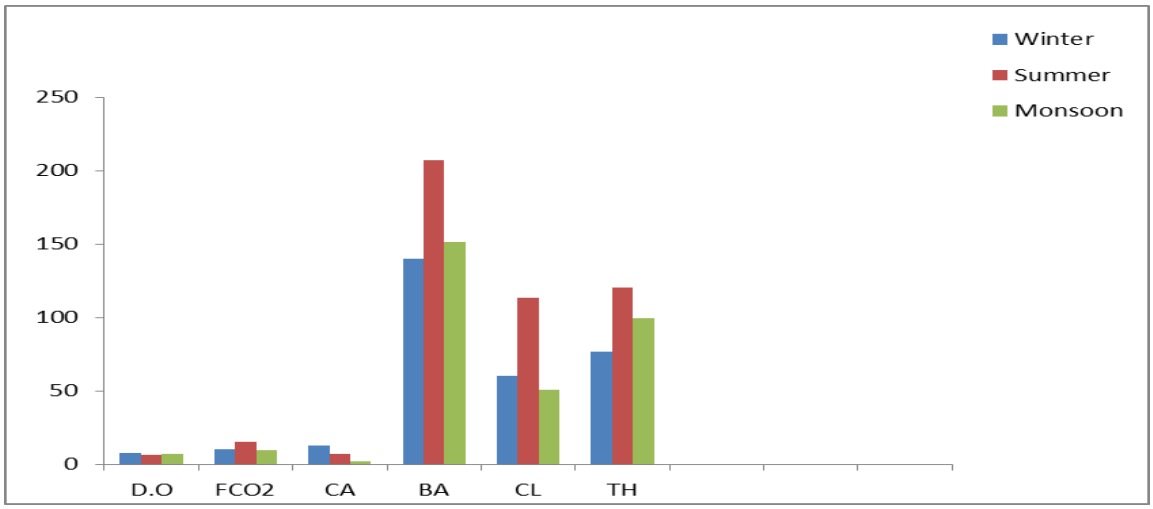
Table-3: Mean And Standard Deviation Of Hydrobiological Parameters Of Gaya Ji Dam, 2023.

Parameters	WT°C	TRANSP	pH	D.O	FCO2	CA	BA	CL	SL	SUL	TH	TN	PHOS	BOD	GPP
Mean	23.8	36.06	7.4	7.12	11.72	7.38	166.25	77.83	19.79	32.25	98.95	0.40	0.52	4.45	1.61
S.D.	3.548	6.565	0.253	0.646	2.827	7.778	30.82	28.06	7.36	6.92	19.05	0.16	0.084	1.08	0.261

Table-4: Correlation Matrix Of Hydrobiological Parameters Of Gaya Ji Dam, 2023.

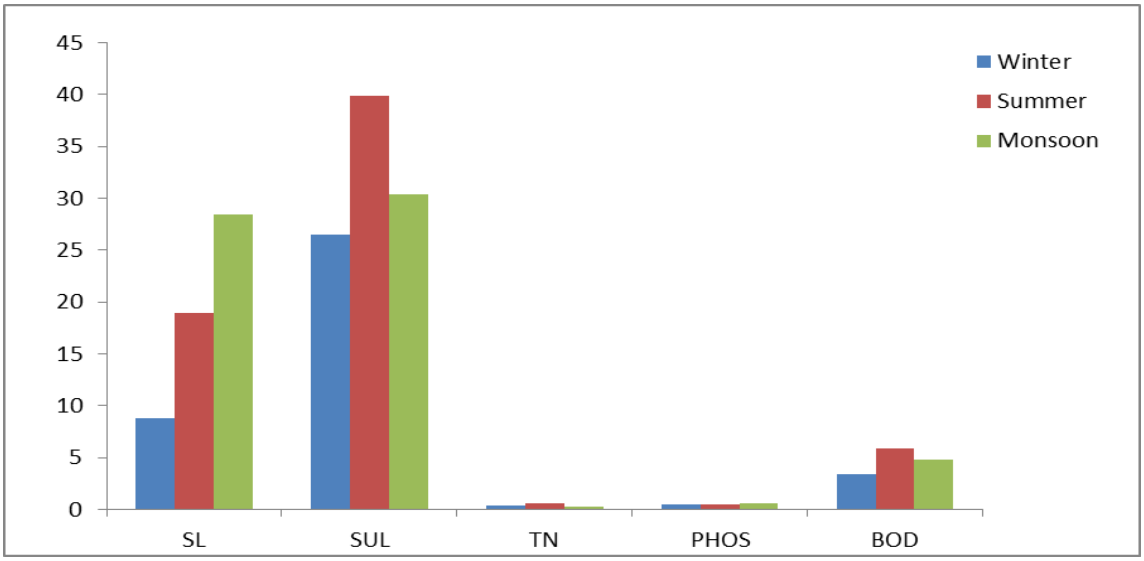
	WT°C	TRANSP	pH	D.O	FCO2	CA	BA	CL	SL	SUL	TH	TN	PHOS	BOD	GPP
WT°C	1														
TRANSP	0.5748	I													
pH	-0.6011	0.0280	I												
D.O	-0.8260	0.08506	0.81786	I											
FCO2	0.8735	0.56367	-0.75869	-0.79648	I										
CA	-0.5081	-0.21488	0.12518	0.514933	-0.343	I									
BA	0.4263	0.66205	-0.61713	-0.66791	0.5990	-0.371	I								
CL	0.3303	0.20390	-0.56841	-0.35747	0.6077	-0.175	0.6202	I							
SL	0.7470	0.20223	-0.59174	-0.83276	0.7948	-0.439	0.7677	-0.257	I						
SUL	0.9069	0.64192	-0.53277	-0.69443	0.8772	-0.434	0.9189	0.5195	0.6122	I					
TH	0.6203	-0.03267	-0.89774	-0.81730	0.7355	-0.254	0.7016	0.6790	0.6275	0.6308	I				
TN	0.1935	0.247100	-0.40837	-0.21538	0.5088	0.3410	0.5025	0.9294	0.3218	0.3981	0.5625	I			
PHOS	0.5773	-0.10797	-0.48862	-0.74164	0.3984	-0.569	0.3689	-0.248	0.7275	0.4986	0.4869	0.0079	I		
BOD	0.6538	0.17158	0.84551	-0.75150	0.8083	-0.103	0.8024	0.8362	0.5963	0.7399	0.9231	0.6603	0.26	I	
GPP	0.8950	0.32186	0.52547	0.819268	0.6670	0.5969	-0.695	-0.008	-0.781	0.6828	0.5512	0.0133	0.84	-0.46	1

WT°C = Water temperature WC = Water colour T = Turbid PT = partially turbid
C = Clear FCO2 = Free carbon dioxide CA = Carbonate Alkalinity BA = Bi carbonate Alkalinity CL = Chloride SL = Silicate SUL = Sulphate TH = Total Hardness TN = Total Nitrogen PHOS = Phosphate Transp. = Transparency



Values in mg/L

Fig. 2: A. Seasonal variations of Dissolved Oxygen, Free carbon dioxide, Carbonate alkalinity, Bicarbonate alkalinity, Chloride content and Total Hardness of Gaya Ji dam.



Values in mg/L

Fig.2B. Seasonal variations of Silicate, Sulphate, Total Nitrogen, Phosphate and Biological Oxygen Demand of Gaya Ji dam.

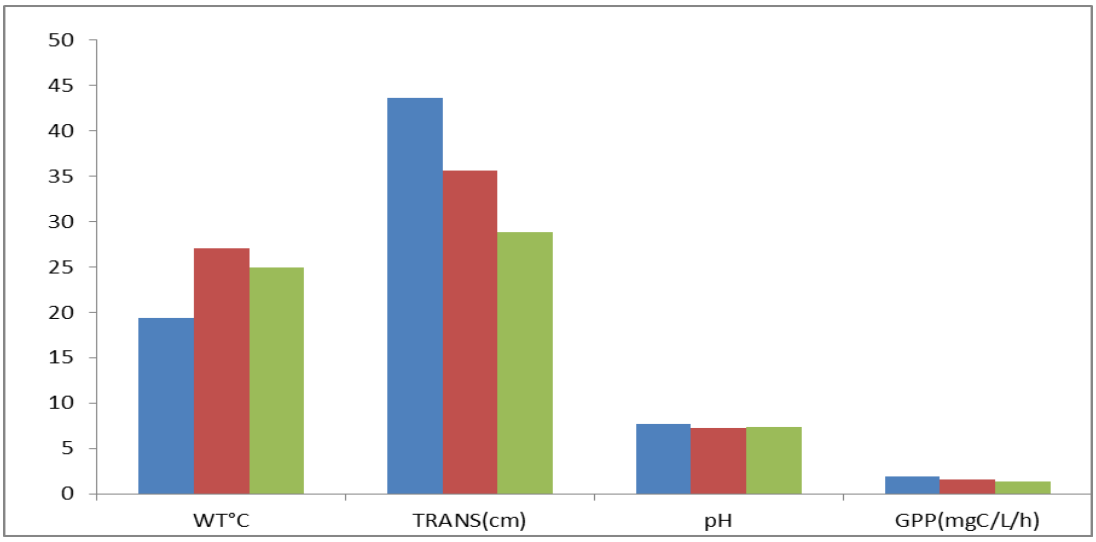


Fig.2: C. Seasonal variations of Water temperature, Transparency, pH and Gross primary productivity of Gaya Ji dam.

CONCLUSION

The study of various hydrobiological parameters and their statistics reveals that the quality of water was alkaline, nutrient rich and productive which support directly and indirectly the growth of phytoplankton, zooplankton and ichthyofauna. The data obtained during investigation period of various hydrobiological parameters were almost fall within the limit range but not considered as a hygienic for human consumption.

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