International Journal of Environmental Sciences
ISSN: 2229-7359
Vol. 10 No. 4s, 2024
https://theaspd.com/index.php

Physicochemical Analysis Of Two Freshwater Ponds Of Patna Of Bihar: A Comparative Study

Swati Kumari[1], Mikki Kumari[2], Om Prakash Kumar[3], Amit Priyadarshi[4] and Mohita Sardana[5]

[1,2,3,4,5]Department of Zoology, VKS University, Arrah-802301
*Corresponding author email: mohita.sardana23@gmail.com

ABSTRACT

Freshwater ponds are vital ecological resources in urban and peri-urban areas, and are increasingly impacted by human activities. This study compares the physicochemical properties of two freshwater ponds in Patna district, Bihar, to assess their water quality and ecological health. Seasonal samples were analyzed for key parameters using standard methods. The ponds' distinct variations were influenced by urbanization and land use, with one exhibiting higher nutrients, turbidity, and biological oxygen demand, indicating moderate pollution. The other showed better dissolved oxygen levels and healthier conditions. Seasonal changes were evident, with higher nutrients during the monsoon and increased dissolved solids in summer. Overall, both ponds are affected by anthropogenic inputs, highlighting the need for regular monitoring and effective management to support conservation of urban freshwater ecosystems in Bihar.

Keywords: *Physicochemical parameters; Freshwater ponds; Water quality assessment; Comparative study; Patna (Bihar); Seasonal variation; Anthropogenic impact.*

INTRODUCTION

Freshwater ponds are vital for biodiversity, ecological balance, and ecosystem services, groundwater recharge, nutrient cycling, fisheries, and water supply, especially in tropical regions like India. However, rapid urbanization and unplanned development have severely degraded many of these water bodies. Physicochemical parameters—such as temperature, pH, dissolved oxygen, alkalinity, hardness, and nutrients—are key indicators of water quality and directly affect aquatic life; their alteration can disrupt the integrity of ecosystems [1-4]. Seasonal variations strongly influence the physicochemical and biological characteristics of surface waters [5]. In regions with pronounced seasonal changes, higher summer temperatures enhance microbial activity and chemical reactions, reduce oxygen levels, and increase parameters such as BOD [6]. In contrast, cooler and rainy winter conditions, with lower temperatures and greater dilution, result in higher dissolved oxygen levels, slower biological processes, and relatively improved water quality indices [7]. In Patna, increasing urban expansion has intensified anthropogenic pressures on ponds through sewage, runoff, and waste disposal, yet scientific data on their water quality are limited. This study analyzes and compares the physicochemical characteristics of two freshwater ponds in Patna to assess their water quality and provide baseline information for effective management and conservation of urban freshwater ecosystems.

MATERIALS AND METHODS

(A) Study area

Patna (25°36′45.64″ N; 85°09′31.95″ E), the capital and largest city of Bihar, is situated on the southern bank of the River Ganga. The district lies on a flat alluvial plain and is uniquely located near four major rivers—the Ganga, Sone, Gandak, and Punpun. Patna district has a total geographical area of 3,172 km² and is administratively divided into six subdivisions, Patna Sadar, Patna City, Barh, Masaurhi, Danapur, and Paliganj, comprising 23 blocks. Patna Sadar subdivision includes blocks such as Sampatchak and Phulwari Sharif.

Phulwari Sharif (25°34′39″ N; 85°04′46″ E) is a town and block within Patna district and is part of urban Patna. As of 2024, the estimated population of Phulwari Sharif Nagar Parishad is approximately 118,000. The town is situated 8 km from Patna city along National Highway 98 on Khagaul Road. Historically, Phulwari Sharif was a famous centre of Sufi culture and served as a hub of social, religious, and cultural activities in ancient times.

Manikchand Pond and Phulwari Sharif Pond are two prominent freshwater bodies in the Phulwari Sharif region, possessing considerable ecological, socio-economic, and historical importance for the local community. However, increasing human settlement, discharge of untreated domestic wastewater, agricultural runoff, religious activities, and encroachment have progressively altered their natural balance and adversely affected water quality.

(B) Sample collection and analysis

Water samples were collected in triplicate from selected sites of two ponds monthly from a 15 cm depth of superficial layer from 2023 to 2024. Each water sample was preserved and analyzed for eleven parameters: water temperature, pH, turbidity, conductivity, dissolved oxygen, total alkalinity, hardness, total dissolved solids, chloride, nitrate, biochemical oxygen demand using the standard methodology [8]. The observed values (mean±SD) in seasonal and temporal variations in water quality are represented in Tables 1 to 2.

Observed data were analysed using Graph Pad Prism 5 software for correlation and two-way t-test. We selected $p<0.05$ as the significance level.

RESULTS AND DISCUSSION

Seasonal fluctuations of certain abiotic factors from 2023 to 2024 in pond, their national and international standards, as well as statistical analysisof Phulwarisharif Patna are presented in Tables 1 to 4.

During the study period, the minimum water temperature was recorded in January (11.78°C in Manikchand Pond and 10.84°C in Phulwarisharif Pond), while the maximum temperature occurred in June (34.91°C and 33.19°C, respectively). A two-way t-test revealed a highly significant difference in mean water temperature between the two ponds ($t = 25.61$; $p< 0.001$) (Table 4). The observed temperature range is comparable with earlier reports from Bihar [1-3] and other regions of India [9]. Most of the recorded values fall within the optimal range (13.5–32 °C) reported to support planktonic development [10].

pH is an important indicator of water quality. During the present investigation, the pH ranged from 7.03 to 7.66 in Manikchand Pond and 7.09 to 7.86 in Phulwarisharif Pond, with values within the national and international water quality standards (Table 3). A two-way t-test revealed a highly significant difference in mean pH between the two ponds ($t = 6.07$; $p< 0.001$) (Table 4). Both ponds had a slightly alkaline nature. Lower pH values observed during summer may be attributed to increased free CO_2 resulting from accelerated decomposition at higher temperatures. A comparatively higher pH in Phulwarisharif Pond may be due to greater removal of free CO_2 during daytime and higher concentrations of carbonates and bicarbonates.

Electrical conductivity ranged from 258.9–356.6 µmho/cm in Manikchand Pond and 479.8–676.6 µmho/cm in Phulwarisharif Pond. Mean conductivity values exceeded national and WHO-recommended standards but remained within the permissible limits prescribed by ICMR (Tables 3 and 5). A two-way t-test revealed a highly significant difference in mean conductivity between the two ponds ($t = 29.23$; $p< 0.001$) (Table 4). Comparable conductivity ranges have been reported from other freshwater bodies in India (Kumar 2010, Prasad et al. 2019), indicating wide spatial variability. The relatively high conductivity values suggest eutrophic conditions in both ponds. Electrical conductivity reflects the ionic composition of water and is closely associated with the chloride, hardness, nitrates, total alkalinity, total dissolved solids, and dissolved oxygen.

Mean turbidity was recorded as 28.78 ± 3.89 NTU in Manikchand Pond and 25.36 ± 4.40 NTU in Phulwarisharif Pond, with values exceeding national and international water quality standards (Tables 1 and 3). A two-way t-test indicated a significant difference in mean turbidity between the two ponds ($t = 2.35$; $p< 0.05$) (Table 4). Elevated turbidity levels may be attributed to runoff and rainfall-induced disturbances, as reported in earlier studies [1-2].

Dissolved oxygen (DO) ranged from 5.13–6.42 mg/l in Manikchand Pond and 5.10–5.98 mg/l in Phulwarisharif Pond, indicating moderate pollution and values below national and international water quality standards (Table 3). A two-way t-test revealed a moderately significant difference in mean DO between the two ponds ($t = 3.56$; $p< 0.01$) (Table 4). Dissolved oxygen is a critical parameter for the survival of aquatic organisms, and both seasonal and spatial variations were observed during the study period. Higher DO levels recorded in winter are attributable to increased oxygen solubility at lower temperatures. Reduced DO during summer may result from higher temperatures, enhanced microbial decomposition, and increased biochemical oxygen demand (BOD). Persistently lower DO levels in Phulwarisharif Pond may be associated with greater oxygen consumption due to oxidisable organic matter from domestic sewage inputs, consistent with earlier finding [11].

Biochemical oxygen demand (BOD) ranged from 17.06–79.81 mg/l in Manikchand Pond and 14.99–75.16 mg/l in Phulwarisharif Pond, with values exceeding national and international water quality standards (Table 3). A two-way t-test revealed a significant difference in mean BOD between the two ponds ($t = 2.17$; $p< 0.05$) (Table 4). Higher BOD values during the monsoon and summer seasons are attributed to increased organic waste input and enhanced bacterial activity. The low winter values may result from reduced microbial metabolism due to lower temperature and light intensity. These findings are consistent with earlier report [12].

Total alkalinity ranged from 102.6–138.8 mg/l in Manikchand Pond and 210.9–275.4 mg/l in Phulwarisharif Pond, indicating high productive potential in both water bodies. The recorded values were within national and international water quality standards (Table 3). A two-way t-test revealed a highly significant difference in mean total alkalinity between the ponds ($t = 14.87$; $p < 0.001$) (Table 4). The observed alkalinity levels are comparable with earlier reports from ponds and rivers across Bihar and other regions of India, indicating broad agreement with previous finding [3].

Total hardness ranged from 72.4–123.4 mg/l in Manikchand Pond and 135.5–144.6 mg/l in Phulwarisharif Pond. As values exceeding 180 mg/l classify water as very hard, both ponds fall within acceptable limits and comply with national and international water quality standards (Table 3). A two-way t-test revealed a highly significant difference in mean total hardness between the two ponds ($t = 12.72$; $p < 0.001$) (Table 4). The observed hardness levels are comparable with earlier reports from freshwater bodies in Bihar and other regions of India, indicating general agreement with previous studies [13].

Total dissolved solids (TDS) ranged from 131.8–178.7 mg/l in Manikchand Pond and 431.2–665.2 mg/l in Phulwarisharif Pond. TDS values in Phulwarisharif Pond exceeded the prescribed standard limits (Table 3). A two-way t-test indicated a moderately significant difference in mean TDS between the two ponds ($t = 7.14$; $p < 0.001$) (Table 4). The observed TDS levels are comparable with reports from other freshwater bodies across India, which show wide spatial variation [14, 15]. Total dissolved solids generally exhibit a positive relationship with electrical conductivity; however, conversion factors and regulatory standards may vary depending on water chemistry and regional guidelines.

Chloride concentration is a reliable indicator of domestic sewage contamination in aquatic ecosystems, as human and animal excreta contain substantial amounts of chloride [16]. During the present investigation, chloride levels ranged from 21.10–31.74 mg/l in Manikchand Pond and 19.26–30.76 mg/l in Phulwarisharif Pond. The observed concentrations were within national and international water quality standards (Table 3). A two-way t-test revealed a moderately significant difference in mean chloride concentration between the two ponds ($t = 3.47$; $p < 0.01$) (Table 4). The comparatively lower chloride levels in Phulwarisharif Pond indicate reduced sewage input and anthropogenic disturbance, whereas higher concentrations in Manikchand Pond suggest sewage influence. Elevated chloride levels during summer may be attributed to reduced water volume, increased evaporation, and contaminated runoff from surrounding settlements, corroborating earlier findings that high chloride concentrations are indicative of pollution of animal and sewage origin.

Nitrate concentration is a key parameter for assessing organic pollution, representing the highest oxidized form of nitrogen. During the present study, nitrate levels ranged from 6.01 to 6.59 mg/l in Manikchand Pond and 8.19 to 8.58 mg/l in Phulwarisharif Pond, indicating eutrophic conditions. The observed values were below the prescribed national and international water quality standards (Table 3). A two-way t-test revealed a highly significant difference in mean nitrate concentration between the two ponds ($t = 4.49$; $p < 0.001$) (Table 4). Higher nitrate levels during the rainy season may be attributed to nitrogen-rich floodwaters carrying contaminated sewage, while elevated concentrations during summer are likely due to accelerated decomposition of organic matter under high temperatures and increased sewage input.

CONCLUSION

The findings of the present study indicate that sewage pollution has become a significant environmental concern in the state. Although the study may appear limited in scope, the results highlight a critical issue, particularly in economically underdeveloped and politically sensitive areas. Small-scale ecological disturbances, if unaddressed, may escalate into broader environmental and social challenges. Therefore, there is an urgent need for effective environmental management and widespread public awareness, extending from grassroots communities to policymakers. Such measures are essential to realize the long-term vision of sustainable ecological development in the region.

REFERENCES

1. Karla N, Kumar R, Yadav SS, Singh RT (2012): Seasonal variation of some physico-chemical of water in Ara Block of Bhojpur District, Bihar. Der Pharmacia Lettre. 4(2): 515-521.
2. Mishra AK, Hasan S (2013): Assessment of water quality of Libri River, Purnia (Bihar). Int Res J Sc Eng. 1(2): 63-68.
3. Rai AK, Diba F, Paul B (2013): A study on the seasonal variations of different physicochemical water quality parameters of Indrapuri Dam Rohtas District Bihar. Internat. J. Environ. Sci. 2(3): 125-129.
4. Singh L, Achint R, Kaur V (2024): Studies on Physico-Chemical Parameters of Water in Ponds and Lakes of India. JFMR. 7(1): 1-7.

5. Silas II (2018): Seasonal Variation in Water Quality Parameters of River Mkomon Kwande Local Government Area, Nigeria, 5(1).
6. Abba EH (2021): Assessment of water quality of Oum Er Rabia River by Microbiological Quality Index and Water Quality Index, Pollution, 7(3).
7. Zulić M, Jukić H, Aldžić A, A. Ćehajić A (2019): Microbiological Analysis of Surface Waters in the Area of National Park 'Una, New Technologies, Development and Application, 42: I. Karabegović, Ed., in Lecture Notes in Networks and Systems, Cham: Springer International Publishing, 568–574.
8. APHA (2012): Standard methods for the examination of water and waste waters, 25th Ed. Washington, DC. USA.
9. Bajpai O, Mishra S, Mohan N, Mohan J, Gupta RK (2013): Physico Chemical Characteristics Of Lakhna Devi Temple Water Tank, Lakhna, Bakewar, Etawah, U.P. With Reference To Cyanobacterial Diversity. Internat J Environ. 1(1): 21-28.
10. Gaikwad SR, Ingle KN, Thorat SR (2008): Study of zooplankton pattern and resting egg diversity of recently dried water bodies in north Maharashtra region. J Environ Biol. 29: 353-356.
11. Singh M (1995): Impact of human activities on the physic-chemical conditions of two fish ponds at Patna, Bihar. J. Freshwat. Biol.7:13-17.
12. Kumar P, Sonaullah F, Wanganeo A (2010): A preliminary limnological study on Shershah Suri Pond, Sasaram, Bihar. Asian. J. Exp. Sci. 24(2): 219-226.
13. Prasad BN, Jaitly YC, Singh Y (1985); Periodicity and interrelationships of physicchemicalfactors in pond. Proc. Nat. Symp. Pure and Applied Limnology (ed Adoni A.D.) Bull. Bot.Soc. Sagar, 32, 1-11.
14. Thakre GN, Shrivastava D, Mishra A, Bajpai (2010): Limnological studies to assess the water quality of Tapti pond at Multai district, Betul (MP), Int. J. Chem. Sci. 8 (4): 2105–2114.
15. Sharma RC, Singh N, Chauhan A (2016): The influence of physico-chemical parameters on phytoplankton distribution in a head water stream of Garhwal Himalayas: A case study. Egyptian J Aqat Res. 42:11-21.
16. Singh AK (1997): Abundance of macrobenthic organism in relation to the physicochemical characteristics of River Ganga at Patna (Bihar) India. J. Environ. Biol. 18(2): 103-110.

Table 1. Physicochemical parameters of water of Manikchand Pond, Anisabad, Patna, during 2023-2024.

	Water Temp. (^{0}C)	pH	Conductivity (µmho/cm)	Turbidity (NTU)	Dissolved Oxygen (mg/L)	Biochemical Oxygen Demand (mg/L)	Total Alkalinity (mg/L)	Hardness (mg/L)	Total Dissolved Solid (mg/L)	Chloride (mg/L)	Nitrate (mg/L)
JUL	31.65±2.45	7.15±.0.23	339.4±20.8	30.9±5.21	5.31±0.84	12.71±.4.93	132.7±4.92	120.1±4.25	178.7±8.79	24.88±1.14	6.52±0.22
AUG	29.84±3.21	7.20±0.13	340.8±21.9	30.2±5.46	5.60±0.23	17.06±6.71	138.8±6.43	116.5±4.71	174.7±4.27	29.08±0.30	6.54±0.12
SEP	27.59±2.94	7.31±0.15	356.6±18.8	29.3±5.06	5.66±0.90	18.32±5.71	128.4±3.16	123.4±4.20	164.5±5.86	31.74±0.18	6.59±0.42
OCT	25.36±2.71	7.48±0.26	345.7±19.8	34.5±5.68	5.80±0.74	23.60±5.73	128.5±2.08	108.4±6.34	163.5±6.05	25.33±0.94	6.05±0.61
NOV	21.89±3.22	7.49±0.33	297.8±20.5	33.3±9.42	5.93±0.45	22.62±6.31	114.6±4.78	96.3±6.16	152.6±4.07	21.42±1.16	6.01±0.71
DEC	14.31±3.72	7.53±0.41	274.8±21.2	30.3±7.02	6.06±0.85	17.14±6.31	113.8±3.17	79.6±5.15	131.8±8.96	22.77±0.92	6.05±0.41
JAN	11.78±3.80	7.66±0.21	258.9±20.4	22.9±5.36	6.16±0.23	20.75±5.24	102.6±4.02	72.4±3.65	138.4±3.26	21.19±1.12	6.08±0.11
FEB	19.41±3.25	7.43±0.35	280.2±42.9	23.2±5.24	6.42±0.74	21.56±4.66	118.2±3.04	78.5±4.28	171.6±3.65	23.46±1.00	6.10±0.80
MAR	26.12±2.54	7.24±0.46	300.4±27.8	23.3±5.02	6.15±1.21	54.49±7.23	132.4±5.84	73.7±4.86	136.8±5.67	23.65±6.58	6.02±0.60
APR	28.42±1.19	7.18±0.59	319.4±25.8	28.4±5.81	5.88±0.88	39.07±3.14	138.6±6.65	82.4±5.51	148.6±3.89	28.60±2.24	6.09±0.21
MAY	32.92±1.47	7.14±0.43	337.3±24.7	30.3±9.36	5.55±0.36	79.81±3.43	119.8±4.24	119.3±5.88	170.8±6.57	27.34±2.88	6.28±0.84
JUN	34.91±1.93	7.03±0.51	352.3±18.7	31.4±5.67	5.13±0.16	65.49±2.62	125.6±4.84	122.8±2.46	176.7±5.32	26.35±3.24	6.44±0.65

Mean	**24.48±7.24**	**7.32±0.19**	**316.97±33.41**	**28.78±3.89**	**5.86±0.37**	**32.72±22.06**	**124.5±10.95**	**99.45±20.97**	**159.05±16.79**	**25.48±3.25**	**6.23±0.23**

Table 2. Physico-Chemical parameters of water of Phulwari Sharif Pond, Phulwari Sharif, Patna, during 2023-2024.

	Water Temp. (^{0}C)	pH	Conductivity (µmho/cm)	Turbidity (NTU)	Dissolved Oxygen (mg/L)	Biochemical Oxygen Demand (mg/L)	Total Alkalinity (mg/L)	Hardness (mg/L)	Total Dissolved Solid (mg/L)	Chloride (mg/L)	Nitrate (mg/L)
JUL	31.45±2.54	7.20±0.40	678.6±10.72	31.3±6.04	5.19±0.24	14.99±1.25	272.7±6.98	234.5±4.65	630.2±8.79	21.99±1.50	8.42±0.92
AUG	29.48±3.12	7.27±0.18	643.9±12.8	30.6±6.85	5.36±0.40	16.05±1.39	268.1±6.39	221.7±4.51	604.8±4.02	27.10±1.18	8.47±0.52
SEPT	27.98±2.49	7.39±0.16	622.8±13.4	29.8±7.92	5.58±0.17	21.79±1.81	258.8±3.86	223.4±4.58	561.7±4.18	24.79±1.03	8.41±0.95
OCT	24.63±2.17	7.41±0.28	602.0±20.6	26.8±8.41	5.70±0.24	17.62±1.78	257.4±2.98	210.8±6.92	594.6±3.74	23.27±0.92	8.25±0.71
NOV	20.89±2.23	7.82±0.21	554.8±20.7	23.8±8.13	5.98±0.38	12.25±1.03	235.2±4.26	187.1±6.36	574.6±3.82	19.48±0.98	8.35±0.19
DEC	14.13±3.27	7.95±0.25	509.8±23.6	21.6±3.24	5.97±0.27	12.49±1.51	210.9±3.76	144.6±5.59	491.8±3.25	20.77±1.46	8.23±0.96
JAN	10.84±5.93	7.86±.0.13	479.8±5.96	20.3±8.04	5.87±0.93	18.26±.4.41	211.0±4.21	145.6±3.45	431.2±3.96	19.26±0.45	8.24±0.74
FEB	16.96±6.42	7.66±0.22	520.8±12.4	20.6±7.23	5.70±0.23	26.54±4.74	227.9±3.24	143.2±4.58	645.0±3.63	22.07±0.94	8.27±0.21
MAR	25.04±5.21	7.52±0.45	516.6±13.18	20.8±8.14	5.62±0.41	37.96±5.86	222.5±4.69	145.4±8.48	502.3±8.14	25.23±0.89	8.19±0.74
APR	27.07±2.81	7.37±0.17	602.5±15.2	23.8±8.23	5.51±0.38	75.16±6.66	263.3±8.25	165.4±9.78	525.6±12.8	27.39±1.83	8.27±0.81
MAY	30.29±1.74	7.19±0.26	626.5±9.84	23.5±6.49	5.49±0.45	65.21±5.69	275.4±6.61	202.6±8.84	627.9±11.1	30.36±2.10	8.36±0.65
JUN	33.19±1.39	7.09±0.41	625.5±10.18	31.4±7.85	5.10±0.20	14.99±1.25	253.5±7.89	222.8±4.46	665.2±14.8	23.87±2.42	8.58±0.51
Mean	**24.33±7.16**	**7.48±0.29**	**581.97±63.20**	**25.36±4.40**	**5.59±0.28**	**27.76±21.15**	**246.39±23.68**	**187.25±36.31**	**571.24±71.02**	**23.89±3.37**	**8.31±0.12**

Table 3. Comparison of the average value of physico-chemical parameters of water of Manikchand Pond and Phulwari Sharif Pond, Patna, with National and International standards of drinking water quality

Parameters	Manikchand Pond	Phulwari Sharif Pond	BIS (2009) Standard	WHO (2011) Standard	ICMR Standard	European Standard	USPH (1962) Standard
pH	7.32±0.19	7.48±0.29	6.5-8.5	7.0-8.5	6.5-8.5	6.5-8.5	6.0-8.5
Total Alkalinity (mg/L)	124.5±10.95	246.39±23.68	200	200	440	200	200
Hardness (mg/L)	99.45±20.97	187.25±36.31	300	300	300	500	500

Total Dissolved Solid (mg/L)	159.05±16.79	571.24±71.02	500	600	500-1500	500	500
Chloride (mg/L)	25.48±3.25	23.89±3.37	250	250	250-600	250	250
Nitrate (mg/L)	6.23±0.23	8.31±0.12	50	45	20-50	30	30
Dissolved oxygen (mg/L)	5.86±0.37	5.59±0.28	5.0	3.0-6.0	-	-	-
Conductivity (µmho/cm)	316.97±33.41	581.97±63.20	300	300	1000-2250	-	-
Biochemical oxygen Demand (mg/L)	32.72±22.06	27.76±21.15	3.0	3.0-6.0	-	-	-
Turbidity (NTU)	28.78±3.89	25.36±4.40	1	1.5	-	-	-

Table 4. Comparison of values of different physicochemical parameters of water of Manikchand Pond and Phulwari Sharif Pond, Patna (Tabulated r at df: 11 = 0.553 at 5%, 0.684 at 1% and 0.755 at 0.1% level and tabulated t at df: 22 and 2.07 at 5%, 2.82 at 1% and 3.79 at 0.1% level).

Parameters	Manikchand Pond V/S Phulwari Sharif Pond				Parameters	Manikchand Pond V/S Phulwari Sharif Pond			
	Calculated r value	Level of significance	Calculated t value	Level of significance		Calculated r value	Level of significance	Calculated t value	Level of significance
WT (^{0}C)	0.992	p<0.001***	25.61	P<0.001**	pH	0.887	P<0.001***	6.07	P<0.001***
Cond. (µmho/cm)	0.994	P<0.001***	29.23	p<0.001**	DO (mg/L)	0.748	P<0.01**	3.56	P<0.01**
BOD(mg/L)	0.565	P<0.05*	2.17	P<0.5*	TA (mg/L)	0.650	P<0.05*	2.71	P<0.05*
TH (mg/L)	0.971	p<0.001**	12.78	p<0.01**	TDS (mg/L)	0.914	p<0.001***	7.14	p<0.001***
Chloride (mg/L)	0.739	P<0.01**	3.47	P<0.01*	Nitrate (mg/L)	0.817	P<0.01**	4.49	P<0.001***
Turbidity (NTU)	0.596	P<0.05*	2.35	P<0.05*					

(NS = Not significant, *=Significant, **=Moderately Significant, ***= Highly Significant)