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Studies on physico-chemical parameters of water samples of Sonbarsa Tilabay River (Koshi), District Saharsa, Bihar

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Abstract : The Koshi river is the major tributaries of the Ganges which originates from the snowy peaks of Tibetan plateau in the central Himalayas. A branch of Koshi River passing near Sonbarsa block, popularly known as Tilabay River. The physic-chemical parameters of Koshi River, Saharsa, Bihar have been studied monthly during August 2017 to July 2018 from two sites. This paper deals with the air temperature and physico-chemical parameters like temperature, transparency, pH, oxygen, carbon dioxide, alkalinity, hardness, chloride and biological oxygen demand of water of Sonbarsa River (Koshi area) of Saharsa district. The water temperature was recorded maximum in summer season but the transparency, pH, dissolved oxygen, total alkalinity and total hardness were recorded maximum in winter season. Similarly, free carbon dioxide was higher in rainy season and chloride and biological oxygen demand were recorded maximum in summer season. The results revealed that there was significant seasonal variation in some physic-chemical parameters and most of the parameters are in the normal range indicating better quality water resources.

Key words: Physico-chemical parameters, Sonbarsa Tilabay River (Koshi area)

INTRODUCTION

The study site is Sonbarsa Tilabay River of Saharsa district of Koshi area. The quality of water resources is usually described according to its physical, chemical and biological characteristics. For confirming the good quality of water resources, large numbers of physico-chemical and biological parameters are to be studied in detail and must be found in normal range. In any rational formulation and deciding quality of water resources an adequate knowledge of existing nature of physico-chemical parameters, magnitude and source of any pollution load must be known, for which monitoring of physico-chemical parameters and chemical parameters and pollutants is essential. For effective maintenance of water quality through appropriate control measures, continuous monitoring of large number of quality parameters is essential. However it is very difficult and laborious task for regular monitoring of all the parameters even if adequate manpower and laboratory facilities are available. Therefore, in recent years an alternative approach based on statistical correlation, has been used to develop mathematical relationship for comparison of physico-chemical parameters. Assessment of water resource quality from any region is an important aspect for the development activities of the region, because the rivers, lakes and manmade reservoirs are used for water supply to domestic, industrial, agriculture and fish culture use.

Mostly the water resources are being used for various purposes such as domestic use, agriculture and fish culture etc. by local community. Particularly Sonbarsa block

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belongs to rural are of dense population of district Saharsa. In future there is threat of contamination of water from the surface runoff of used fertilizers and pesticides. Although extensive works on the physico-chemical parameters have already been carried out. As there is no sufficient baseline data about physico-chemical parameters of Koshi river water, hence the present work has been undertaken for monitoring the physico-chemical characteristics.

MATERIALS AND METHODS

Sonbarsa (Tilabai River) of Saharsa District, Bihar was selected for study. This river is a branch of Koshi. The study area was visited monthly and the surface water samples were collected by using samplers (Plastic containers of 5 litre size) from two sites of the river. Some physical and chemical parameters such as light transparency, water temperature, pH and dissolved oxygen were determined in the field during the visits given for collection of water sample. For the certain parameters such as electrical conductivity, total alkalinity, hardness, magnesium, calcium, chloride, free CO_2, hydrogen sulphide (H_2), nitrate, phosphate, sodium, potassium and total solids etc., the water sample was collected and preserved with preservative and analysed in laboratory. The analysis of physico-chemical parameters were carried out by

Table 1 (a): Physico-chemical parameters of the river water from August 2017 to September 2018.

Parameters	August, 2017		September, 2017		October, 2017		November, 2017		December, 2017		January, 2017	
	S_1	S_2	S_1	S_2	S_1	S_2	S_1	S_2	S_1	S_2	S_1	S_2
Water Temp. (^{0}C)	27.5	27.3	29.6	28.8	31.2	31.0	29.8	30.1	25.6	24.3	25.4	25.1
Light trans. (cm)	22.3	13.2	24.5	17.5	29.6	23.8	42.6	48.2	42.1	48.2	40.5	40.5
PH	7.8	7.9	7.7	8.0	8.1	8.1	8.3	8.0	7.7	7.9	7.8	8.0
EC ((μ mdhs)	0.532	0.608	0.557	0.559	0.501	0.498	0.415	0.417	0.418	0.420	0.419	0.422
DO	6.32	6.75	6.66	6.41	5.71	6.32	8.49	8.58	11.78	12.98	9.52	10.10
Free CO_2	3.78	3.45	4.52	4.12	4.51	4.78	6.52	6.17	6.22	6.35	3.54	3.86
Total alk.	395.0	312.0	375.5	175.4	418.2	413.5	430.5	398.6	492.0	499.3	296.0	273.0
Hardness	210.3	215.1	185.6	184.9	220.1	215.6	181.0	175.9	240.5	255.9	209.3	205.6
Magnesium	27.99	28.79	24.01	22.32	27.41	27.89	20.12	18.45	33.56	39.15	23.56	24.12
Calcium	38.14	40.19	36.54	37.82	42.01	35.26	38.97	42.58	38.79	37.22	45.18	43.19
Chloride	42.56	57.26	39.37	41.58	42.53	39.41	21.51	22.13	30.15	24.78	22.84	25.98
Nitrate	27.0	27.0	30.0	29.0	31.0	47.0	29.0	25.0	29.0	27.0	33.0	31.0
Phosphate	0.17	0.22	0.16	0.17	0.14	0.15	0.12	0.15	0.16	0.18	0.20	0.21
Sodium	35.0	39.0	30.0	36.0	32.0	32.0	32.0	30.0	33.0	49.0	35.0	31.0
Potassium	5.3	5.5	5.3	5.0	5.1	5.3	5.2	4.9	5.2	4.8	5.6	4.5
H_2S	0.678	0.279	0.845	0.398	0.674	0.789	0.423	0.125	0.426	0.279	0.549	0.542

Note: S_1 = Site first, S_2 = Site Second; Values expressed in mg/l, except water temp., Light trans., Ph and EC.

following standard method as described by APHA *et al.*, (2012) and Kumar *et al.*,(2015). Transparency, air temperature and water temperature were recorded between 12 noon and 1 p.m. For the analysis of physico-chemical parameters, methods of Welch (1952), Michael (1984), Trivedi and Goel (1984), Adoni *et al*. (1985) and APHA (1998) were adopted.

RESULTS AND DISCUSSION

There are sixteen (16) physico-chemical parameters of the river water were determined monthly from two sites during the period August 2017 to July 2018, and results were summarized in the table 1 (a) and 1(b). Temperature is one important physico-chemical parameter which is directly related to chemical reactions in aquatic ecosystem. In present investigation water temperature is ranging in between 24.3°C to 33.5°C and found seasonal change in it. Similar results were reported by Goel *et al.* (1986). The seasonal variation in air temperature was little higher (30.13°C) in rainy season in comparison to that of summer (29.55°C) and lowest in winter season during the first year study period. During the second year study period, the air temperature was recorded little higher in summer than rainy season and lowest was found in winter.

The pH of water of the Koshi river increaseda little in August then a slight decrease was recorded in September.

Table 1 (b): Physico-chemical parameters of the river water from August 2017 to September 2018.

Parameters	February, 2018		March, 2018		April, 2018		May, 2018		June, 2018		July, 2018	
	S_1	S_2	S_1	S_2	S_1	S_2	S_1	S_2	S_1	S_2	S_1	S_2
Water Temp. (^{0}C)	26.0	25.9	29.3	28.7	31.5	31.7	33.5	32.7	29.8	29.1	30.2	30.6
Light trans. (cm)	37.2	36.0	38.6	35.5	28.7	31.0	26.0	30.2	14.6	35.0	14.5	32.1
PH	7.6	7.8	7.8	7.9	8.2	8.0	8.1	7.8	7.8	7.6	7.9	8.1
EC ((μ mdhs)	0.385	0.401	0.415	0.410	0.423	0.478	0.562	0.558	0.632	0.651	0.641	0.63
DO	9.45	9.12	7.35	7.49	8.86	8.67	9.82	8.76	10.55	12.85	11.23	11.48
Free CO_2	1.52	1.25	2.58	2.36	1.00	0.65	0.52	0.26	3.56	3.42	4.85	4.42
Total alk.	253.0	255.3	259.5	249.9	223.2	220.4	261.8	274.0	265.0	272.3	261.3	256.8
Hardness	112.0	135.0	105.0	95.0	202.0	185.0	215.0	208.0	229.0	227.0	195.0	221.0
Magnesium	19.45	20.42	18.52	16.35	22.03	22.06	24.58	17.45	16.48	17.24	22.13	23.85
Calcium	41.07	38.27	31.59	30.14	37.89	36.45	47.52	46.71	65.99	62.84	45.26	49.15
Chloride	31.56	30.24	32.58	34.89	33.87	45.16	34.25	33.16	52.17	57.08	57.19	64.06
Nitrate	31.0	28.0	33.0	37.0	33.0	32.0	31.0	32.0	34.0	37.0	42.0	38.0
Phosphate	0.20	0.18	0.21	0.23	0.17	0.19	0.15	0.14	0.18	0.20	0.18	0.15
Sodium	33.0	32.0	30.0	35.0	33.0	31.0	29.0	33.0	37.0	36.0	38.0	34.0
Potassium	5.5	4.9	5.6	4.8	5.2	4.5	5.3	5.1	5.2	5.6	5.0	5.3
H_2S	0.535	0.475	0.425	0.566	0.478	0.536	0.758	0.985	0.546	0.854	0.542	0.795

Note: S_1 = Site first, S_2 = Site Second; Values expressed in mg/l, except water temp., Light trans., Ph and EC.

Again it increased from October to January then decreased from February to May and increased from June to July during the first year study period.

The water transparency or light penetration is highly variable parameter and helps in determining productive zone of water body. In present study seasonal change in light transparency was observed. The pH of water is alkaline and value ranges from 7.6 to 8.3. The higher pH values may be due to photosynthetic activity in water body as reported by King (1970), and may helps in photosynthesis of phytoplankton.

Electric conductance and hardness content of water was in the normal range of fresh water as reported by Bhosale *et al.*(1994).

The study of dissolved oxygen shows seasonal variation and shows increased oxygen level during winter season. The range of oxygen is in between 5.71 to 12.98 mg/l. Similar variation in oxygen was reported by Khatavkar *et al.* (1989) and Bhosale *et al.* (1994). Free carbon-dioxide in water occurs due to respiration of aquatic biota, decomposition of organic matters and also due to infiltration through the soil. The range or free CO_2 is in between 0.26 to 6.52 mg/l. higher level might be due to mixing of atmospheric CO_2 with rain water which ultimately enters into the wetland and also due to active decomposition of organic matters (Sinha, 1995, 2002).

Total alkalinity of water varies seasonally and ranges from 220.4 to 499.3 mg/l. The increase in alkalinity was recorded during winter season. Analogous variation in alkalinity was reported by Goel *et al.* (1985).

Generally, water temperature is influenced by air temperature and intensity of solar radiation. It was highest in summer and lowest in winter. Highest value ecorded in summer might be due to high air temperature and greater light penetration and comparatively low volume of water than rainy season. The water temperature showed positive and significant correlation with free carbon dioxide and biological oxygen demand but had inverse and significant correlation with transparency, pH, dissolved oxygen, total alkalinity and total hardness. Bose and Gorai (1993) reported negative significant correlation between water temperature and dissolved oxygen. Welch (1952) and Munawar (1970) have observed that shallower the water body more quickly it reacts to the change in the temperature. The maximum pH of present study was in winter season followed by rainy and summer seasons. The maximum pH in winter season may be attributed to algal blooms because Roy (1955) had shown that the higher pH is associated with the maximum phytoplankton.

The minimum pH recorded in summer may be due to low photosynthesis. Several workers have reported low pH during the low photosynthesis due to the formation of carbonic acid (Hannan and Yong, 1974; Cabecadas and Brogueira, 1987; Bais *et al*., 1995). But, Gautam (1990) reported highest pH in summer and lowest in rainy season. The maximum dissolved oxygen found in winter season may be due to low temperature. Similar observations were made by Moitra and Bhattacharya (1965). The minimum dissolved oxygen was found in summer due to high temperature, and higher microbial demand of oxygen for decomposition of suspended organic matter (Bhowmick and Singh, 1985; Palharya and Malviya, 1988). Elmore and West (1961) stated that an increase in temperature of water results in the decrease of dissolved oxygen content of water.

Seasonally, the maximum chloride content was recorded in summer followed by winter and rainy seasons. The maximum quantity of chloride recorded in summer season may be due to low volume of water, high temperature and high rate of decomposition of organic matters. Chloride concentration indicates the presence of organic waste of animal origin (Thresh *et al.,* 1949). Munawar (1970) has suggested that higher concentration of chloride in water is an index of pollution of animal origin and there is a direct relation between chloride concentration and pollution level.

The suitability of water resource for the irrigational use in agriculture is depending on its salt concentration, especially chloride content. In water chloride content was in the range 21.51 to 64.06 mg/l. According to Swingle (1967), water body containing hardness above 15 ppm is necessary for satisfactory growth of fish. The low calcium and magnesium content present in water resource may responsible for maintaining normal hardness level. Because of limited washing and cleaning activities in river water may be responsible for nil residual chlorine content.

Presence of hydrogen sulphide in eater body is an indication of organic pollution load in it (Olsen and Sommerfeld, 1997). In present study low concentration of H_2S is reported and may be released by bacteria. According to Ganpati (1960), the non-polluted eaters are generally deficient in nitrate and phosphate content, but

certain factors such as discharge of surface runoff from agricultural field and sewage are responsible for increasing nitrate and phosphate content. In present study nitrate and phosphate contents are in the ranges of 25 to 38 mg/l and 0.12 to 0.23 mg/l respectively which are below range indicating oligotrophic nature of river. Similar results were reported by Pandey *et al*. (1999). The sodium and potassium contents are in the ranges of 29 to 39 mg/l and 4.5 to 5.6 mg/l respectively in river water. The higher level of sodium and potassium is due to release of domestic effluents into the system which contains common salt (Baruah, 1995).

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