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WATER QUALITY INDEX OF KALISINDH RIVER, JHALAWAR REGION

Dr. Sunil Kumar Meena
Botany Department, JDB Govt. Girls Collage Kota

ABSTRACT

Water, a prime natural resource, a basic human need and is indeed required in all aspects of life and health for producing food, agricultural activity, energy generation and maintenance of environment and a substance of life and development. The physico-chemical characteristics of kalisindh river water. The study conducted in different sites of Jhalawar district, Rajasthan, India. Jhalawar district is located between 23º 45'20" and 24º 52'17" north latitude and 75º 27'35" and 76º 56'48" east longitude. Water body will be selected after the physico-chemical and ecological study of three sites in Jhalawar district of Rajasthan, 1. Teendhaar 2. Munderi 3.Gagron. The collection of water samples during April, 2023 to March, 2024. The water quality parameters namely transparency (12.00-120.00 cm),turbidity (1.1-140TNU),electrical conductivity (100-600µS cm -1), total dissolved solids (235-501 mgl-1), pH (7.80-9.50), dissolved oxygen (5.00-14.00 mgl-1), free carbon dioxide (0-10 mgl-1), total alkalinity (70-301 mgl-1), total hardness (41-150 mgl-1),chloride (15.62-80.94 mgl-1),nitrate (0.008-0.025 mgl-1),nitrite (0.002-0.022 mgl-1),sulphate (3.5-45.00 mgl-1),potassium (1.8-5.4 mgl-1), biochemical oxygen demand (0.50-6.00 mgl-1), chemical oxygen demand (2.50-27.00 mgl-1), ammonia (nil-0.49 mgl-1),sodium (10.81-41.50 mgl-1)and potassium (1.8-5.3 mgl-1) reflects on the pristine nature of the river. On the basis of various parameters studied, kalishindh river in this stretch can be placed under the category of oligosaprobic. The water quality analysis, indicated that the river water pollution free and can serve as a good habitat for many aquatic animals including endangered species.

KEYWORDS: *Kalishindh River, Water quality, Pollution status.*

INTRODUCTION

Natural resources are the important wealth of our country, water is one of them. Water is a wonder of the nature. "No life without water" is a common saying depending upon the fact that water is one of the naturally occurring essential requirement of all life supporting activities. The problem of water quality deterioration is mainly due to human activities such as disposal of dead bodies, discharge of industrial and sewage wastes and agricultural runoff which are major cause of ecological damage and pose serious health hazards (Meitei *et al.*, 2004). The degree of pollution is generally assessed by studying physical and chemical characteristics of the water bodies (Duran and Suicnz, 2007). Studies related to water pollution of rivers like Godavari, Krishna and Tungbhdra (Mitra, 1982), Cauvery (Somashekar, 1985; Batcha, 1997), Jhelum (Raina et al., 1984), Kosi (Bhatt and Negi, 1985), Morar (Kalpi) (Saksena and Mishra, 1991), Alaknanda (Tiwari et al., 1991), Brahamani (Panda et al., 1991; Mitra, 1997), Betwa (Datar and Vashishtha, 1992), Ganga (Pandey, 1985; Singh et al., 1999; Sahu et al., 2000; Rao et al., 2000), Godavari (Rao et al., 1993; --+565Rafeeq and Khan, 2002), Yamuna (Meenakshi et al., 2002; Anand et al., 2006), Pachin (Hussain and Ahmed, 2002), Irai (Sawane et al., 2004), Tansa (Shaikh, 2004) and Purna (Meitei et al., 2004a,b) have received greater attention from time to time and during recent years. An attempt has, therefore, been made to study water pollution in river kalishindh.

MATERIALS AND METHODS

The study will be conducted in different sites of Jhalawar district, Rajasthan, India. Jhalawar district is located between 23º 45'20" and 24º 52'17" north latitude and 75º 27'35" and 76º 56'48" east longitude covering an area of 6928 sq.km. The district is part of Kota division and is divided into five sub-divisions namely Aklera, Khanpur, Jhalawar, Pirawa, and Bhawanimandi. Administratively the district is divided into 7 Tehsils and 6 Development blocks. There are 1618 revenue Villages and 8 urban towns in the district. Urban and rural population of the district is 2.29 and 11.82 Lakhs respectively. The climate of the district is dry except South-West monsoon season. The cold season is from December to February and is followed by summer from March to June. Period from mid of September to end of November constitutes post monsoon season. Almost entire district is underlain by black cotton soil except for a few small pockets in the north of district where recent alluvium in plain area and Lithosols and Regosols are present. The whole of south Jhalawar has characteristics of the Malwa plateau, an area of rounded bare hills interspersed by plains. The Jhalawar plain stretches in a wide belt from Bhawani Mandi in the west almost up to Asnawar in the east and is bounded in the northern, eastern and southern sides by the Mukandhara hills. The rivers and streams of the entire district belong to the Chambal system. Except in the Gangdhar Tehsil, the general flow is from south to north. The rivers of Jhalawar may be divided into two groups: the western group and eastern

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group. The western rivers are Ahu, Piplaj, Kyasri, Kantli, Rawa, Kalisindh and Chandrabhaga. The eastern rivers are Parwan, Andheri, Newaj, Ghar and Ujar. There are artificial lakes Kadila and Mansarovar. Generally speaking rivers have deep bed. With the result the water level is below that of the surrounding area. Drainage density in most part of the district varies from 0.5 to 0.7 km/km2. Drainage density is from 0.7 to more than1km/km2 in the southeastern and southwestern parts of the district. In the north central part of the district, it is low and ranges between 0.3 to 0.5 Km/Km2.

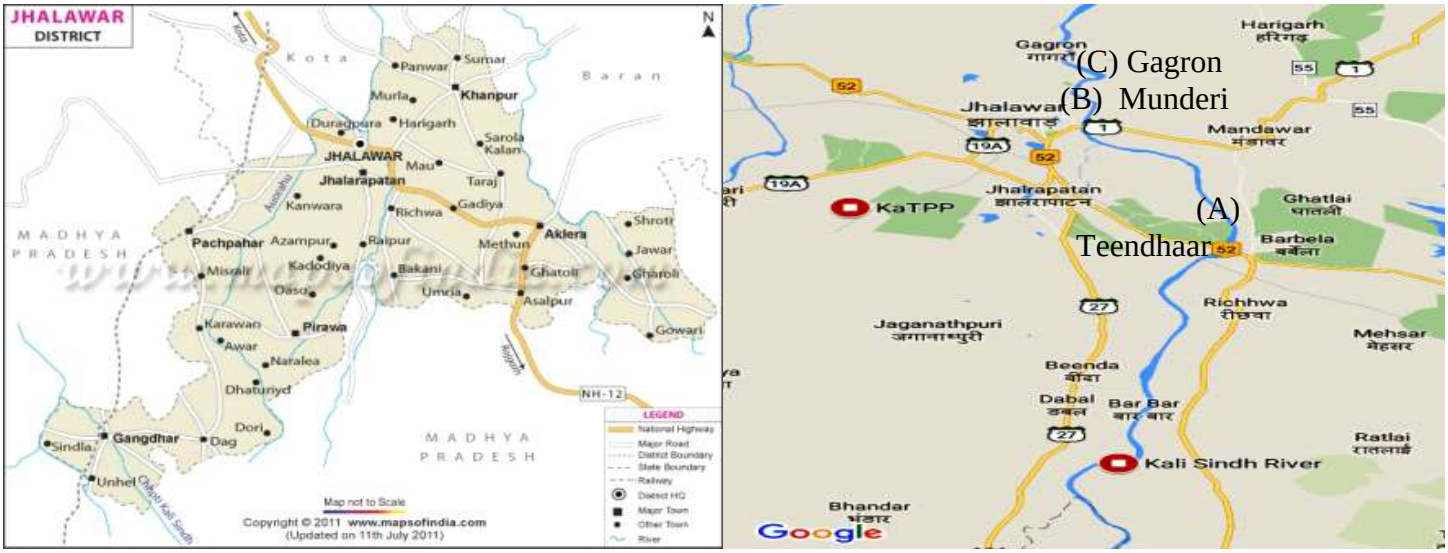

Fig.1: Location Map of Study Area

Three sampling stations were established almost equidistantly on the stretch of kalishindh river. Station-A was established at Teendhaar (near Jhalrapatan District Jhalawar), Station-B was established at Munderi(near Munderi village District Jhalawar), Station-C was established at Gagron(near Gagron village District Jhalawar).

Beyond this station river kalishindh joins to the river Chambal. The water samples were collected from all the three sampling stations established on kalishindh river from April, 20019 to March, 2020. The monthly samples of subsurface water were collected during first week of each month in the early hours of the day i.e. between 7 am to 9 am Utmost care was taken to avoid spilling of water and air bubbling at the time of sample collection. Iodine treated polyethylene double stoppard bottles were used for collection of sample. Some of the physico-chemical characteristics of water including water temperature, transparency, flow rate, pH, dissolved oxygen, free carbon dioxide, total alkalinity, total hardness, chloride, calcium and magnesium were determined at the sampling stations, while other parameters including turbidity, electrical conductivity, total dissolved solids, nitrate, nitrite, phosphate, biochemical oxygen demand, chemical oxygen demand, ammonia, sodium and potassium were analyzed in the laboratory within 4 to 6 hr of collection. The physico-chemical characteristics of water were analyzed according to the methods of APHA (2005) and Trivedy and Goel (1984).

RESULTS AND DISCUSSION

The Physico-chemical characteristics provide a fair idea of the water quality in any water body. The result of the physic-chemical characteristics of Kalisindh river water are summarized in Table 1 and shown in Fig. 2 to23.

Temperature is basically important for its effects on certain chemical and biological reactions taking place in water and aquatic organisms (Shrivastava and Patil, 2002). It depends upon the season, time of sampling and also upon the temperature of effluents which are being added in to the river. Mean annual water temperature in Kalisindh river was given in Table 1. The low water temperature was recorded in winter, while highest was recorded in summer. Similar seasonal variation in water temperature was recorded by Batcha (1998) in river Cauvery, Singh et al. (1999) in river Ghaghara, Nath and Srivastava (2001) in river Narmada, Shrivastava and Patil (2002) in river Tapti and Meitei et al. (2004a) in river Purna.

Transparency or light penetration depends on the intensity of sunlight, suspended soil particles, turbid water received from catchment area and density of plankton etc. (Mishra and Saksena, 1991; Singh, 1999; Kulshrestha and Sha rma, 2006). Transparency of a river water is also affected due to total solids partly or fully decomposed organic matters, silts and turbulence caused by the currents, waves, human and cattle activities (Singh et al., 1999). Seasonal impact was also seen on water transparency indicating higher values during winter and summer seasons, whereas lower values are evident in monsoon season. The transparency values were less in monsoon season due to high current which erodes the bank of the river and due to turbid flood water, suspended matter and dissolved particles. High value of transparency was recorded in late post monsoon and winter months as has also been observed by Singh et al. (1999),

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Nath and Srivastava (2001) and Shaikh and Yeragi (2004). Flow rate of water bodies generally depends upon the amount of water available and on its depth. Mean annual flow rate in Kalishindh river was found to be minimum (14.0 cm sec-1) at Station-B in the month of march and maximum (52.00 cm sec-1) at Station-A in the month of September.

The minimum turbidity (1.00 NTU) was recorded at Station-C in the month of March and maximum turbidity (140.00 NTU) was recorded at Station-C in the month of August.

Conductivity is the measure of capacity of a substance or solution to conduct electrical current through the water. In the present study, lowest conductivity value (100.00 µS cm-1) was observed at Station-A in the month of September and highest value of conductivity (600 µS cm-1) was observed at Station-C in the month of May and jun. Total dissolved solids are composed of carbonates, bicarbonates, chlorides, sulphates, phosphates and nitrates of Ca, Mg, Na, K, and Mn and organic matter, salts and others particles (Mishra and Saksena, 1991). Minimum total dissolved solids (235 mgl-1) were recorded at Station-C, while maximum value (500 mgl-1) was recorded at Station-C in the month of September. Ellis (1937) has observed that a pH range of 6.7 to 8.4 is suitable for the growth of aquatic biota. The water in Chambal River was always alkaline throughout the period of study. Alkaline pH was also observed by Shaikh and Yeragi (2004) in river Tansa during whole study period, while Varma (1998) have observed acidic nature of water of Subernarekha river due to discharge of copper industrial effluents in this river. The minimum pH value (7.40) was recorded at Station-C in the month of October and maximum pH (9.25) was recorded at Station-A in the month of June.

Dissolved oxygen is one of the important parameter in water quality assessment. Its presence is essential to maintain variety of forms of biological life in the water and the effect of waste discharge in a water body is largely determined by the oxygen balance of the system. Dissolved oxygen is regulator of metabolic activities of organisms and thus governs metabolism of the biological community as a whole and also acts as an indicator of trophic status of the water body (Saksena and Kaushik, 1994). Oxygen is generally reduced in the water due to respiration of bio ta, decomposition of organic matter, rise in temperature, oxygen demanding wastes and inorganic reductant such as hydrogen sulphide, ammonia, nitrites, ferrous iron, etc. (Sahu et al., 2000). Inorganic reducing agents such as hydrogen sulphide, ammonia, nitrite, ferrous iron and certain oxidizable substances also tend to decrease dissolved oxygen in water. Tarzwell (1957) has suggested that a minimum of 3 mgl-1 dissolved oxygen is necessary for healthy fish and other aquatic life. In the present study, the minimum value of dissolved oxygen was recorded as 5.00 mgl-1 at Station-B in the month of September and maximum recorded as 14.00 mgl-1 at Station-C in the month of November. This level of oxygen in the river should be able to support good fauna and flora. Similar observation was recorded by Singh and Rai (1999) in river Ganga, Hiware and Jadhav (2001) in river Manjar, Rafeeq and Khan (2002) in river Godavari. The pH, alkalinity and free carbon dioxide are interrelated in aquatic ecosystems. Most of the free carbon dioxide in water comes from the decomposition of organic matter and from respiration of organisms (Singh, 1999). In polluted water, the free carbon dioxide is generally high. In Kalisindh river, free carbon dioxide ranged from non traceable amount at all stations to the maximum value of 10.00 mgl1 at Station-C in the month of August. Good oxygen saturation and low free carbon dioxide indicate no pollution load in the river at all Stations.

Ganapati (1943) attributed that the changes in the values of bicarbonates are associated with the rate of photosynthetic activity. Klein (1959), Shrivastava and Patil (2002) suggested that the alkalinity is directly related to the abundance of phytoplankton which dissociate bicarbonate into carbonates and carbon dioxide. The carbon dioxide, thus, released is used in photosynthesis. George et al. (1966) have opined that with a pH range of 7.0 to 9.0 in water bodies, the bicarbonates concentration remains high. The lowest level of total alkalinity in the Kalisindh river was 70.0 mgl-1 at Station-B in the month of October and highest level was 300.0 mgl-1 at Station-C in the month of June. Similar seasonal variations have been recorded by Singh and Rai (1999) in river Ganga at Varanasi.

Cation of calcium, magnesium, iron and manganese contribute to the hardness of water (Shrivastava and Patil, 2002). Barrett (1953) has reported that the hard waters are more productive than the soft water from fisheries point of view. The minimum value of total hardness in the river was 40.00 mgl-1 at Station-A in the month of June and maximum value was 150.0 mgl-1 at Station-C in the month of November.

Chloride concentration in water indicates the presence of organic waste in water, primarily of animal origin (Thresh et al., 1949). It increases with ammonical nitrogen which also owes itself mostly to animal excreta. Chloride in Kalisindh river varied from 15.62 mgl-1 at Station-A in the month of August to 80.94 mgl-1at Station-C in the month of May. The chloride concentration was quite low in this river which reflects that there is very less amount of organic waste of animal origin and practically no discharge of municipal and industrial wastes. The calcium is one of the most abundant substances of natural water being present in high quantities in the rocks. The disposal of sewage and industrial wastes are also important sources of calcium. The calcium level in the river varied from 9.61 to 43.08 mgl-1 during April to March.

Alderfer and Lovelace (1977) believed that inorganic nitrogen above 0.03 mgl-1 stimulates algal growth to such an extent that water may not be suitable for human consumption. In the river under study, nitrate from to 0.008 mgl-1 at Station-A in the month of March to 0.025 mgl-1 at Station-B in the month of October was recorded. Nitrate-N was found to be quite low

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during the present investigation which reflects that the river does not receive any waste water. Nitrite in the river varied from 0.002 mgl-1 at Station-A in the month of March to 0.022 mgl-1 at Station-A in the month of October, 2019. Sulphate in the river varies from minimum of 3.5 mgl-1 at Station-C to maximum of 45.00 mgl-1 at Station-C in the month of March.

Biochemical oxygen demand (BOD), a pollution indicator, showed its level in river from 0.50 mgl-1 at Station-C to 6.00 mgl-1 at Station-B. Low BOD content indicated that the riverine stretch was free from organic pollution. Fokmare and Musaddiq (2002) recorded high value of biochemical oxygen demand (BOD) as20.00 mgl-1 in river Purna and said that this river is highly polluted due to organic enrichment, decay of plants and animal matter in the river. Chemical oxygen demand (COD) gives us a reliable parameter for judging the extent of pollution in water (Shrivastava and Patil, 2002). COD is the measure of the oxygen required for chemical oxidation of organic matter. In this river, maximum value of COD (24.00 mgl-1) at Station-A during May and minimum value (2.50 mgl-1) at Station- A in July have been recorded. This also provides a direct measure of state of pollution in water bodies (Kulshrestha and Sharma, 2006).

WATER QUALITY AND POLLUTION STATUS OF KALISHINDH RIVER

Table - 1: Analysis of Physico-Chemical Parameters of Kalishindh River

Sl.	Parameter	Unit	Station-A (Teendhaar)			Station-B (Mundari)			Station-C (Gagron)		
			Range of Variation		Mean and Standard Deviation	Range of Variation		Mean and Standard Deviation	Range of Variation		Mean And Standard Deviation
			Min.	Max.		Min.	Max.		Min.	Max.	
1	Water temperature	^{0}C	17.60	31.00	26.47 ± 4.09	17.90	33.00	26.75 ± 4.44	18.10	32.10	26.69 ± 4.33
2	Transparency	Cm	15.50	100.00	67.66+-33.93	12.12	106.20	78.13+-34.50	17.00	110.00	82.48+-35.38
3	Flow rate	cm sec^{-1}	12.50	36.00	19.70+-7.58	6.00	45.00	19.80+-12.09	6.10	46.00	29.68+-11.83
4	Turbidity	NTU	1.60	86.30	20.15+-24.92	1.35	178.00	29.80+-53.35	1.00	107.00	19.70+-29.82
7	Electrical conductivity	µs cm^{-1}	145.60	403.20	283.00+-91.98	100.00	666.40	370.60+-179.99	168.00	884.00	403.33+-248.69
8	Total dissolved solids	mgl^{-1}	270.00	460.00	325.58+-61.13	260.00	450.00	315.58+-59.90	260.00	500.00	307.33+-64.64
9	pH	-	7.90	9.33	8.24+-0.38	8.10	8.92	8.30+-023	7.60	8.98	8.36+-0.34
10	Dissolved oxygen		4.86	10.33	7.66+-1.64	5.06	11.75	7.88+-2.03	5.37	14.59	8.22+-2.71
11	Free carbon dioxide	Mgl^{-1}	Nil	3.30	1.63+-0.57	Nil	6.60	3.02+-1.70	nil	16.50	2.81+-5.46
12	Total alkalinity	Mgl^{-1}	72.50	275.00	145.83+-63.88	70.00	270.00	159.30+-60.32	75.00	290.00	171.04+-62.97
13	Total hardness	mgl^{-1}	42.00	94.00	74.96+-16.95	52.00	134.00	104.31+-26.45	62.00	140.00	106.54+-26.12
14	Chloride	mgl^{-1}	15.62	59.64	29.41+-15.14	16.33	39.76	28.87+-7.29	18.46	80.94	42.16+-23.68
15	Calcium	mgl^{-1}	9.61	31.26	22.50+-5.73	17.60	44.08	27.98+-7.61	19.23	34.46	24.95+-5.07
16	Nitrates	mgl^{-1}	0.008	0.024	0.014+-0.004	0.012	0.025	0.016+-0.003	0.010	0.021	0.0155+-0.003
17	Nitrites	mgl^{-1}	0.002	0.022	0.014+-0.005	0.006	0.020	0.011+-0.003	0.010	0.017	0.012+-0.002
18	Sulphates	mgl^{-1}	8.50	40.40	27.07+-8.85	14.00	42.00	31.11+-9.34	3.50	45.00	24.60+-13.59
19	Phosphates	mgl^{-1}	0.005	0.030	0.018+-0.006	0.006	0.050	0.023+-0.012	0.004	0.045	0.018+-0.009
21	BOD	mgl^{-1}	0.81	3.24	1.79+-0.83	1.01	5.67	2.12+-1.37	0.60	3.24	1.87+-0.78
22	COD	mgl^{-1}	24.40	26.80	10.98+-6.76	4.00	22.50	11.60+-5.79	4.00	17.60	8.33+-4.60
23	Ammonia	mgl^{-1}	Nil	0.56	0.09+-0.16	Nil	0.56	0.152+-0.14	nil	0.54	0.15+-0.18
25	Magnesium	mgl^{-1}	2.43	8.28	461.00+-1.84	1.70	20.17	8.64+-5.79	1.08	14.13	10.92+-4.89
26	Sodium	mgl^{-1}	15.20	52.80	4.56+-9.95	26.80	48.80	38.00+-6.30	14.30	54.40	39.02+-11.55
27	Potassium	mgl^{-1}	3.10	6.10	4.22+-1.03	3.40	6.10	4.89+-0.97	2.10	6.30	4.51+-1.41

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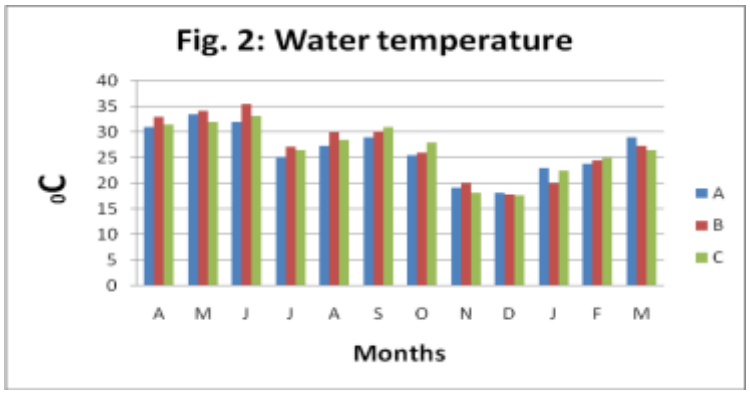

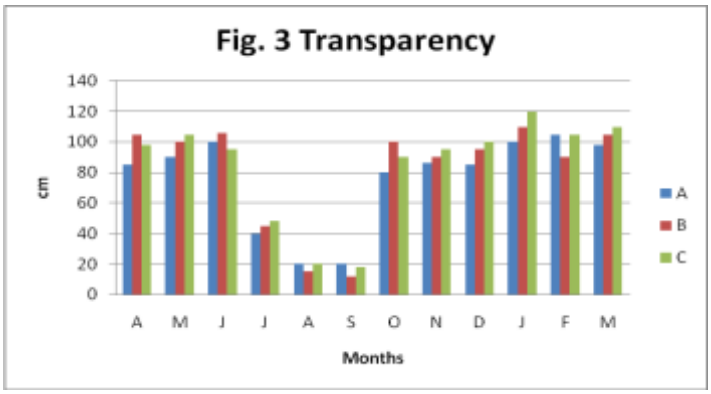

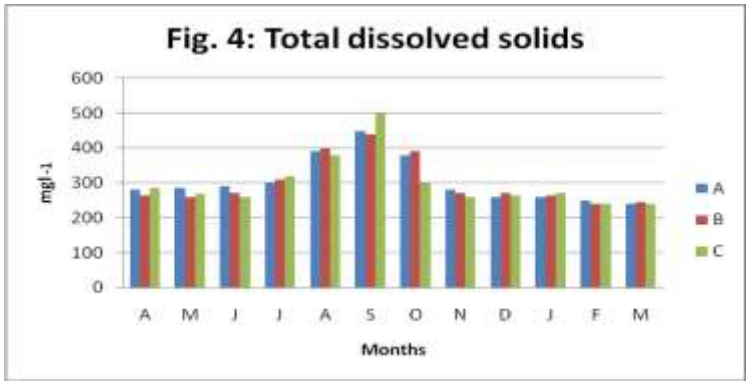

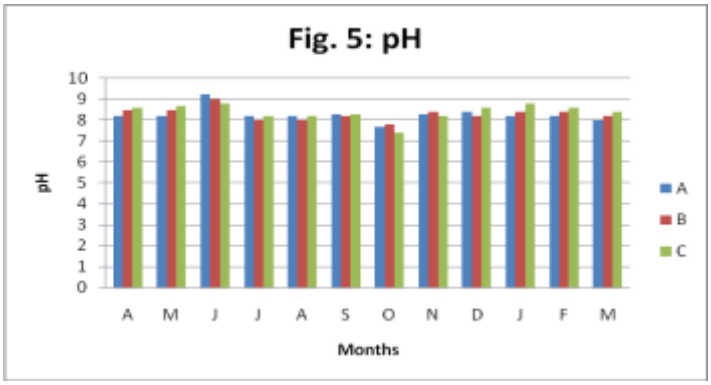

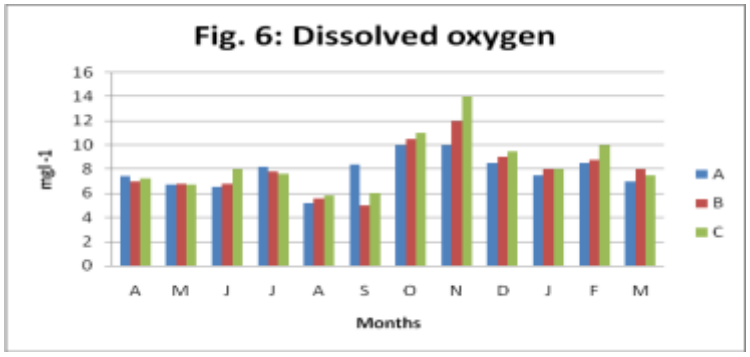

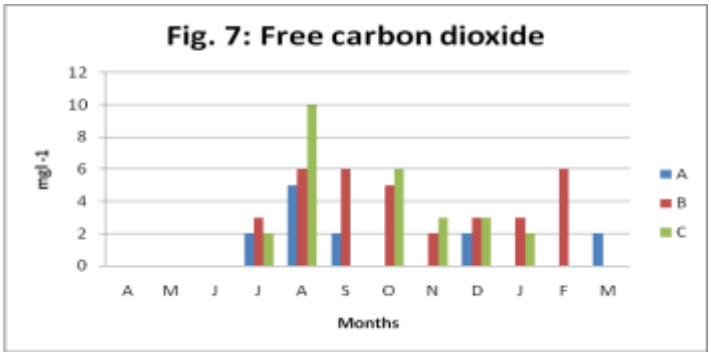

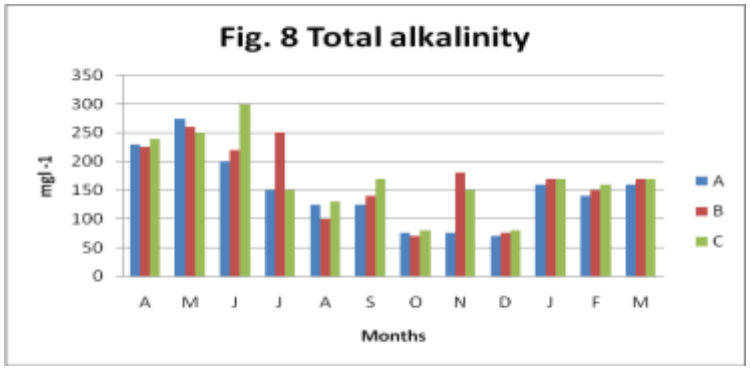

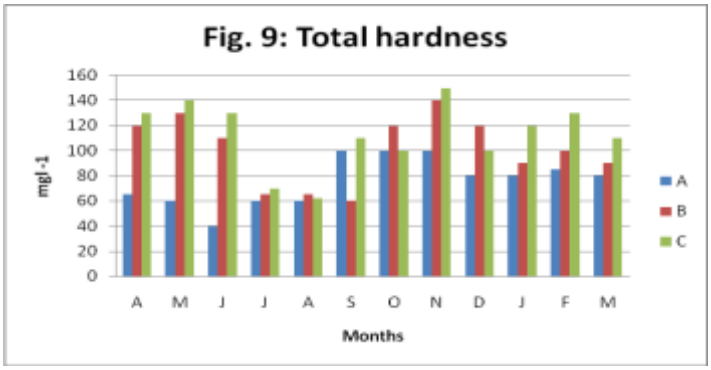

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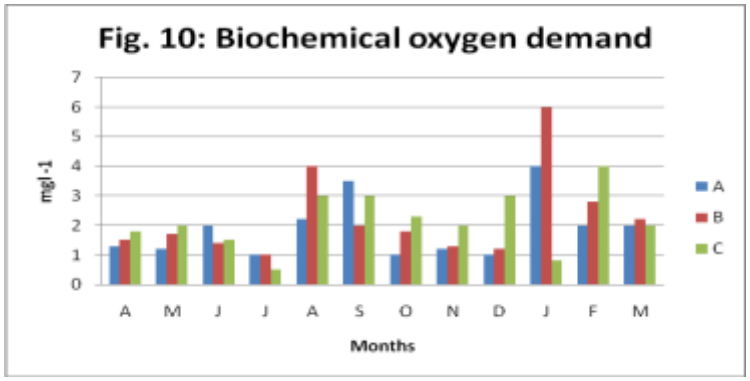


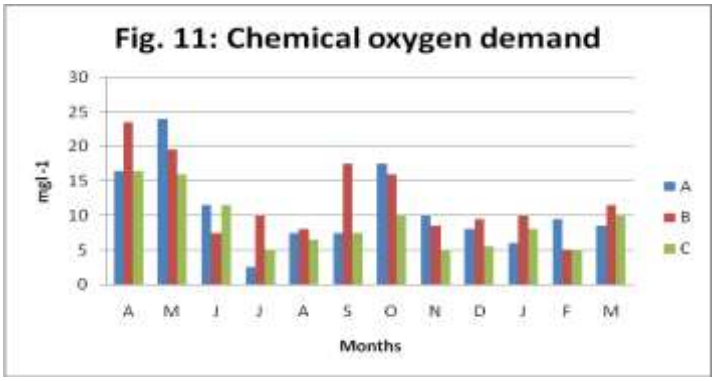
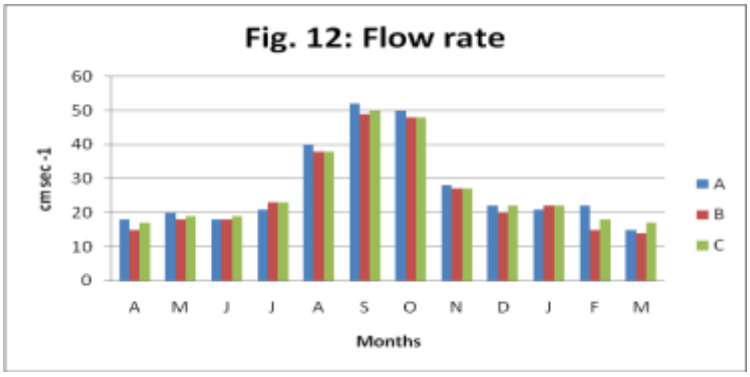
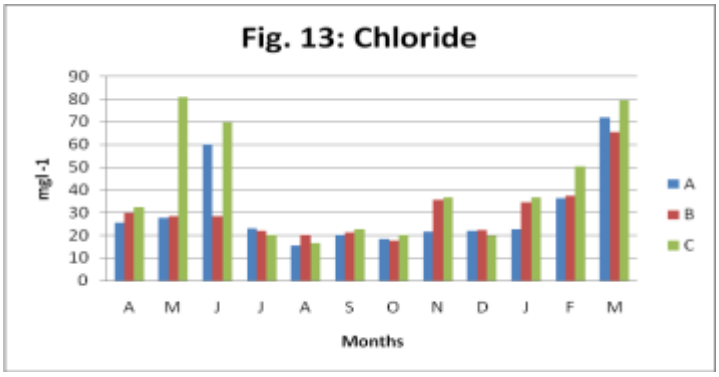
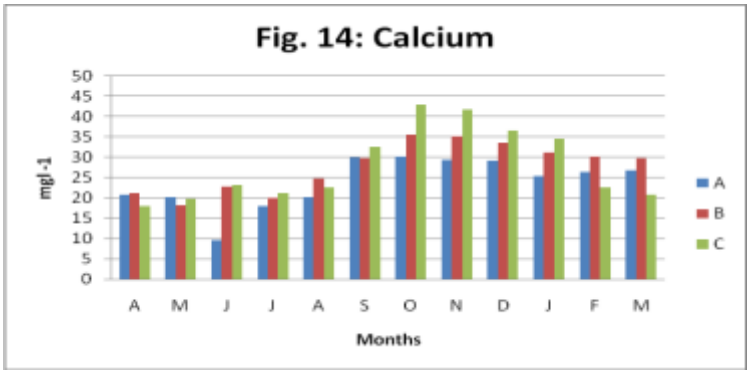
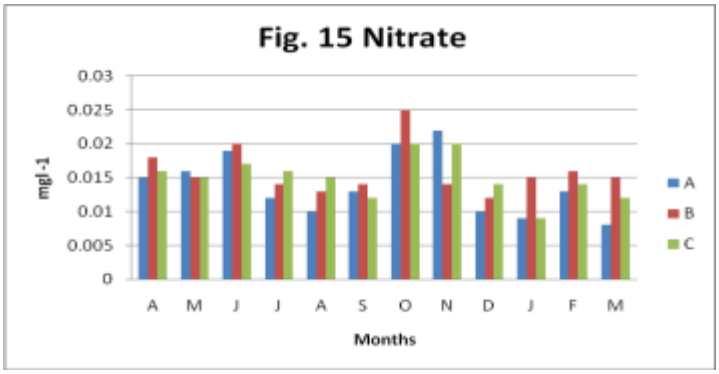


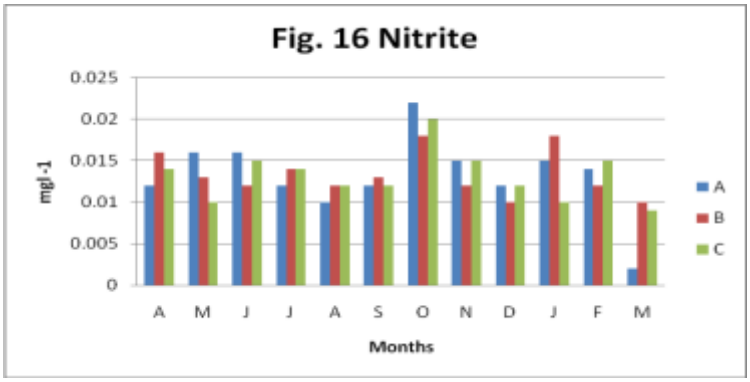
Fig. (2-11) Results of physo-chemical characteristics of Kalishindh river

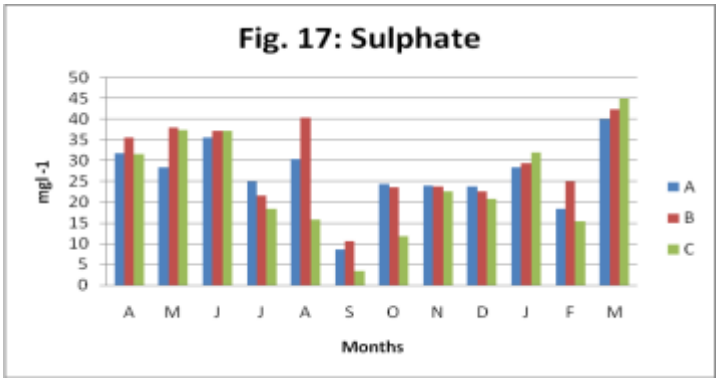












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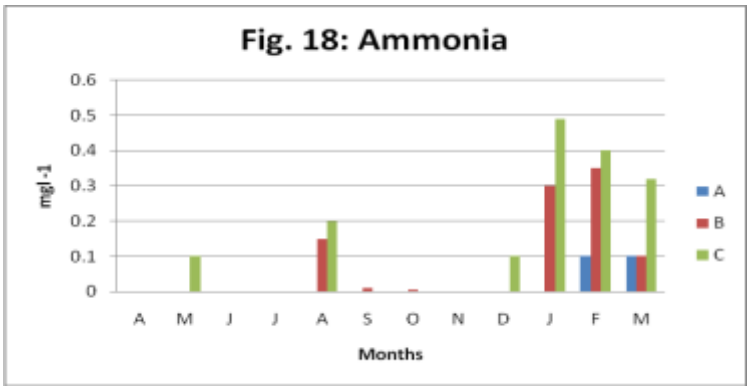
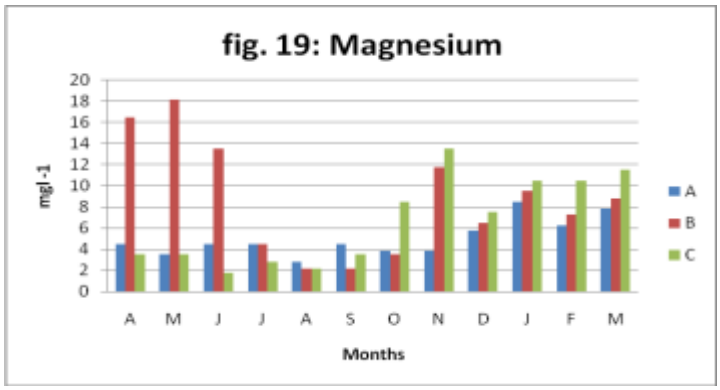
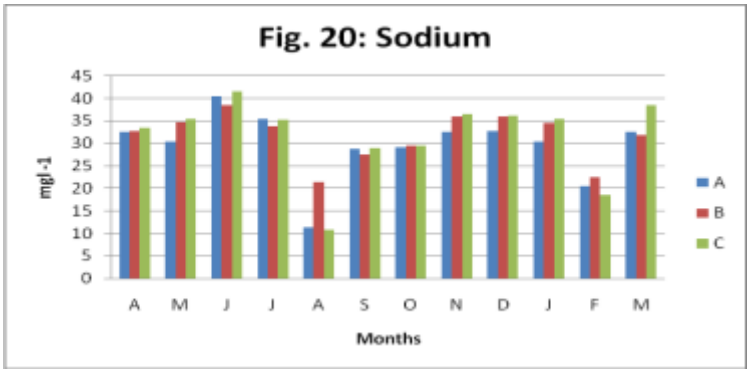






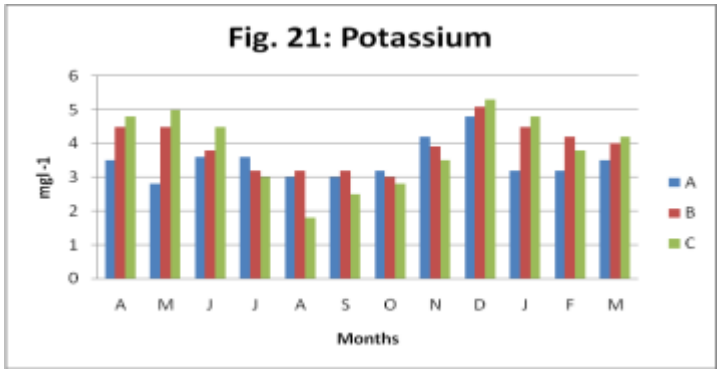
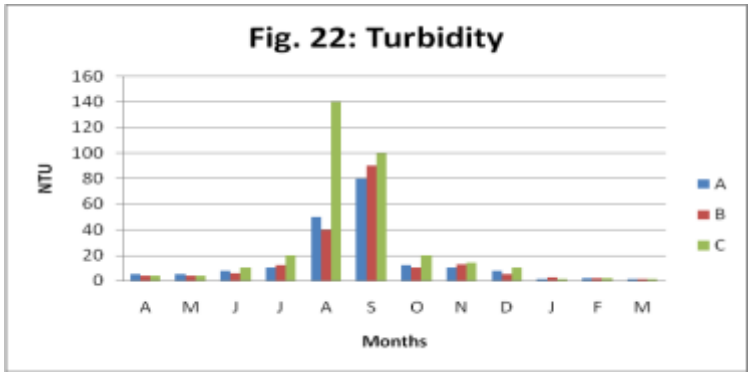


Fig. (12-21) Results of physo-chemical characteristics of Kalishindh river



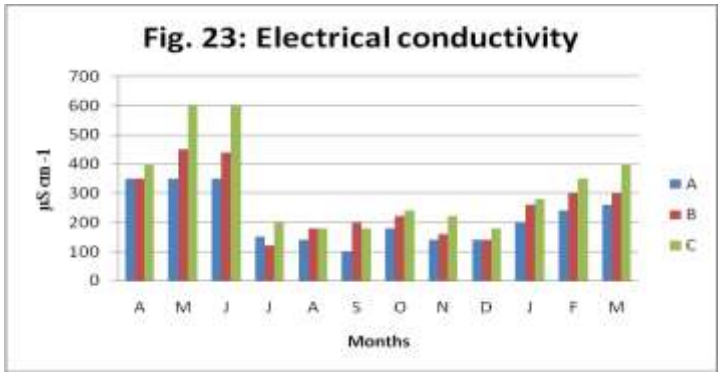


Fig. (22-23) Results of Physo-Chemical Characteristics of Kalishindh River

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Table - 2: Comparison Of Physico-Chemical Parameters of Kalishindh river with that of Indian standards

S. No.	Parameters	Present study on Kalishindh river	IS-2296: 1974 Public water supply	Fish culture	Irrigation
1	Turbidity (NTU)	1.00-178.00	10(IS: 10500:1991)		
2	Electrical conductivity (µS cm-1)	100.00-884.00 1000.00			
3	Total dissolved solids (mgl-1)	240.00-500.00	500		2100.00
4	pH	7.8-9.50	6.00-9.00	6.00-9.00	5.50-9.00
5	Dissolved oxygen (mgl-1)	5.00-14.00	>4.00	>3.00	
6	Free carbon dioxide (mgl-1)	0.00-16.00		6.00	
7	Total alkalinity (mgl-1)	70.00-300.00	200-600 (IS-10500:1991)		
8	Total hardness (mgl-1)	40.00-150.00	300-600 (IS-10500:1991)		
9	Chlorides (mgl-1)	15.62-80.94	600.00		600.00
10	Calcium (mgl-1)	9.61-44.08	74-200 (IS-10500:1991)		
11	Nitrates (mgl-1)	0.008-0.025	50.00		
12	Nitrites (mgl-1)	0.002-0.022	0.020		
13	Sulphates (mgl-1)	3.50-45.00	200-400 (IS-10500:1991)		1000.00
14	BOD (mgl-1)	0.50-6.00	3.00		
15	Ammonia (mgl-1)	0.00-0.56		1.20	
16	Sodium (mgl-1)	14.30-54.40	200		

The presence of ammonia is an evidence of sewage inflow to a water body. However, free ammonia serves as an indicator of aquatic pollution was generally absent or found in traces during most occasions in Narmada river (Nath and Srivastava, 2001). kalishindh river had a range of ammonia concentration between nil at all stations to 0.49 mgl-1 at Station-C in the month of january, 2020. Ammonia in present case indicates no pollution at various stations in the river. Sulphide indicates the amount of organic matter present in water, degradable by sulphur bacteria. kalishindh river water, however, showed a range from untraceable amount of sulphide at all stations to a maximum value of 0.26 mgl-1 at Station-B and C in the month of March.

Magnesium in kalishindh river varies from 1.75 to 18.17 mgl-1 during the period of study. Sodium is one of the important cation occurring naturally. Sodium concentration in irrigation water and soil is of great interest as high sodium contents makes soil hard to plough and unsuitable for seedling emergence. kalishindh water had sodium concentration from 12.30 mgl-1 at Station-C in the month of August to 52.40 mgl-1 at Station-C in the month of June and potassium level from 1.80 mgl-1 at Station-C in the month of August to 5.30 mgl-1 at Station-B in the month of December, suggesting their moderate but harmless concentration.

On the basis of various parameters studied, kalishindh river in this stretch can be placed under oligosaprobic. When various parameters of our study are compared with that of Indian standards (IS,1974, 1991) for public water supply, fish culture and irrigation, it was revealed that all such parameters are well within the limits (Table 2). The water characteristics considered for the study indicate that the river water in the kalishindh river is pollution free and can serve as a good habitat for many aquatic animals including endangered species.

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